Vol. I

TRANSCRIPT OF RECORD

Supreme Court of the United States

OCTOBER TERM, 1929

No. 71

MINERALS SEPARATION NORTH AMERICAN CORPORATION, PETITIONER,

vs.

MAGMA COPPER COMPANY

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FIRST CIRCUIT

PETITION FOR CERTIORARI FILED APRIL 23, 1929

CERTIORARI GRANTED MAY 20, 1929

(34,160)

(34,160)

SUPREME COURT OF THE UNITED STATES

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CHARLES ELMORE

UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FIRST CIRCUIT.

OCTOBER TERM, 1927.

No. 2259.

MAGMA COPPER COMPANY,

DEFENDANT, APPELLANT,

v.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,

PLAINTIFF, APPELLEE.

APPEAL FROM THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, FROM INTERLOCUTORY DECREE (PETERS, J.), APRIL 20, 1928.

TRANSCRIPT OF RECORD.

VOLUME I.

PLEADINGS AND EVIDENCE.

COURT OF APPEALS
1928
FIRST CIRCUIT

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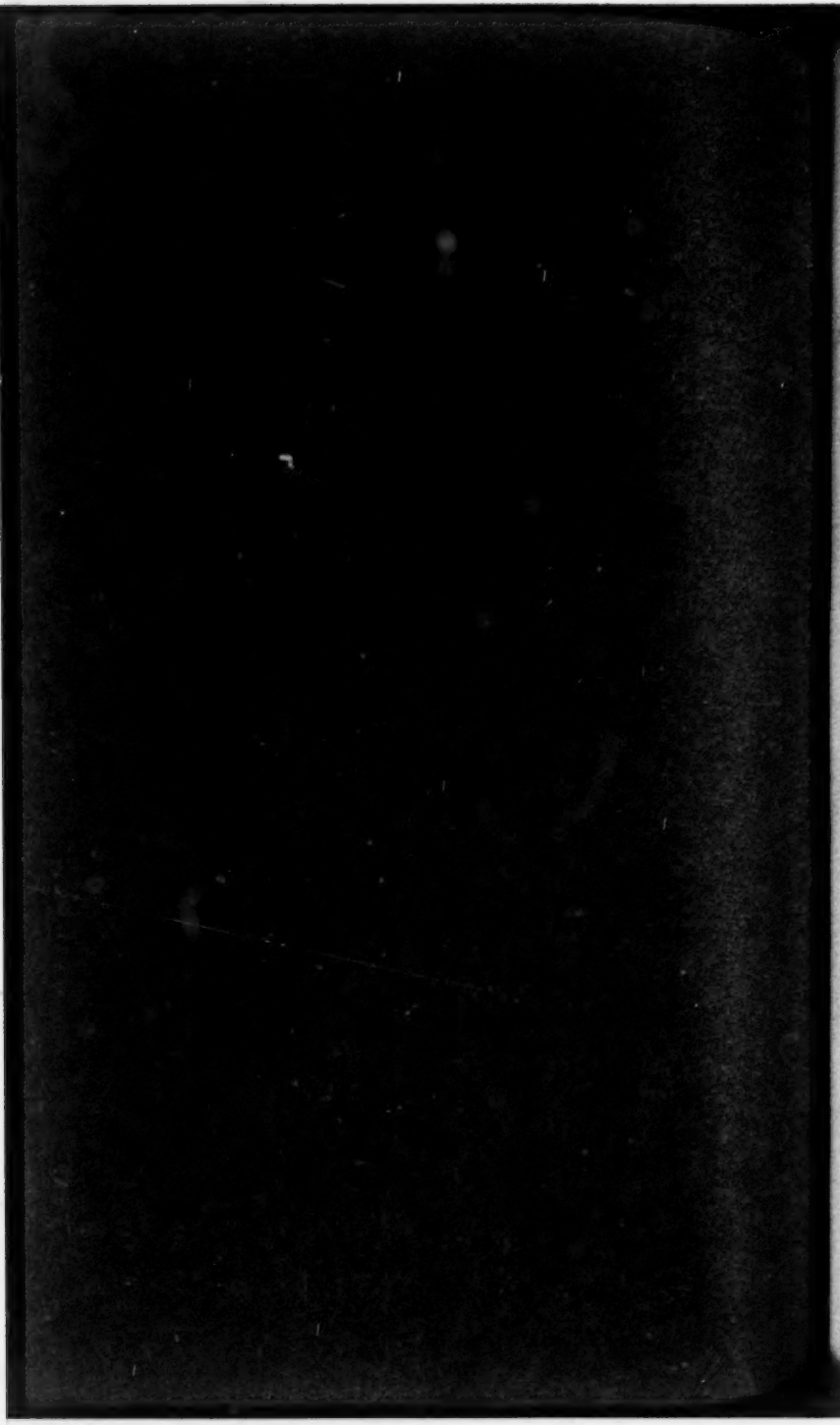

UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FIRST CIRCUIT.

No. 2259. October Term, 1927.

MAGMA COPPER COMPANY,
Defendant-Appellant,

v.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Plaintiff-Appellee.

IN THE

District Court of the United States,

FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

No. 800.

IN EQUITY.

MINERALS SEPARATION NORTH AMERICAN CORPORATION

v.

MAGMA COPPER COMPANY.

DOCKET ENTRIES

Jan.	9, 1920	Bill of Complaint filed.
"	" "	Appearance of Thaxter & Holt for complainant filed.
"	10, "	Subpœna issued returnable Jan. 30, 1921—10 A. M.
"	12, "	Subpœna returned executed. Ent. and filing ret.
"	29, "	App. of Williamson, Burleigh & McLean as attorneys for defendant filed.
"	30, "	Stipulation extending time for filing answer filed and allowed.
Mar.	22, "	App. of Woodman & Whitehouse for Magma Copper Co. filed.
"	24, "	Time for filing answer extended thirty (30) days. (See stipulation on file.)

Mar. 30, 1920.	Time for filing answer extended further period of thirty days. (See stipulation on file.)
Apr. 23, "	Defendant's motion for bill of particulars filed.
" 30, "	Stipulation extending time for filing defendant's answer filed.
" " "	Hearing extended to May 11th, 1920 (Tuesday).
May 11, "	Hearing adjourned to May 26, 1920—9:30 A. M. by stipulation (filing).
July 9, "	Stipulation extending time for hearing on defendant's motion for bill of particulars adjourned to Friday, July 30; also time for filing defendant's answer extended, etc. (See stipulation on file.)
" 30, "	Hearing Hale, *J.* on motion for bill of particulars.
Aug. 2, "	Finding of Court filed.
Oct. 1, "	Defendant's answer filed.
Nov. 2, "	Order for taking deposition *de bene esse* of Leslie Bradford filed. (Hale, *J.*)
Dec. 2, "	Deposition of Leslie Bradford, witness for defendant, filed.
Dec. 30, 1921	Defendant's motion for leave to take deposition of Theodore J. Hoover and order granting same allowed.
Sept. 28, 1922	Supplemental and amended bill of complaint, stipulation and order of Court filed.
" 29, "	Defendant's answer to supplemental and amended bill of complaint filed.
Mar. 22, 1923	Hearing on defendant's motion that case be set for hearing ordered for March 30, '23, 10 A. M.
" 30, "	Hearing Peters, *J.* on motion that case be set for hearing. Hearing set for June 18, '23, at 2 P. M. Bangor.

Mar.	30,	1923. Plaintiff's motion for leave to inspect and to take depositions filed.
"	"	" Hearing on same. Motion granted as per decree filed.
May	21,	" Stipulation of agreement as to mill operations filed by W. & W.
"	21,	" Defendant's Interrogatories filed with order of Court regarding same.
"	31,	" Answers and Objections to Interrogatories filed.
June	6,	" Stipulation *re* deposition *de bene esse* of Theodore J. Hoover filed.
"	"	" Upon oral presentation by counsel each and every of plaintiffs' objections to the interrogatories was sustained, and exceptions to defendant were allowed in each case.
"	11,	" Defendant's motion for further particulars and order, Peters, *J.*, granting same filed.
"	16,	" Defendant's motion for subpoena to Seth Gregory and Arthur H. Higgins and order thereon filed.
"	"	" Subpoena issued in accordance with order of Court.
"	"	" Defendant's motion for subpoena to Wm. S. Stevens and Levi B. Shipley and order thereon filed.
"	"	" Subpœna issued in accordance with Order of Court.
"	29,	" Appearance of Wm. H. Davis for deft. filed.
"	"	" Appearance of John F. Neary for deft. filed.
"	"	" Appearance of Merton W. Sage for deft. filed.
"	"	" Subpœna to Wm. S. Stevens returned executed.
"	"	" Subpœna to Seth Gregory returned executed.

June 29, 1923.	Subpœna to Arthur Howard Higgins returned executed.
" " "	Stipulation as to introduction of translation of German Patent filed.
" 25, "	Hearing begun before Peters, *J.*, at Bangor per stipulation filed.
" " "	Hearing continued from day to day to and including Friday, July 6, 1923.
July 6, "	Arguments made by both sides. Hearing closed.
" " "	Counsel to exchange briefs by Sept. 25, 1923.
" " "	Reply briefs to be filed within two weeks thereafter.
" 20, "	Stipulation that hearing may be held in Northern Division filed.
Aug. 3, "	Order, Peters, J. allowing exhibits to be withdrawn from the files for the purpose of having copies made for inclusion in the printed case filed.
" " "	Order granted upon express condition that Clerk's fees for supervision of printing be paid.
Sept. 22, "	Stipulation that time be extended regarding briefs filed.
Feb. 3, 1928.	Opinion of the court (Peters, J.) filed. Copy forwarded Commissioner of Patents.
Apr. 20, "	Interlocutory decree signed Peters, J. filed.
" " "	Referred to Philip G. Clifford as master to state the account, etc.
May 15, "	Order suspending proceedings before master filed.
" " "	Notice of appeal, acknowledgment of service and order filed.
" " "	Assignment of errors filed.
" " "	Order fixing appeal bond.
" " "	Citation to Circuit Court of Appeals returnable June 14, 1928, with acknowledgment of service filed.
May 16, "	Bond on appeal approved Peters, J.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY.

Minerals Separation North American Corporation and Minerals Separation, Limited,

Plaintiffs,

v.

Magma Copper Company,

Defendant.

BILL OF COMPLAINT.

The plaintiffs for their bill of complaint allege:

First.—That the plaintiff Minerals Separation North American Corporation is a corporation duly organized and existing under and by virtue of the laws of the State of Maryland, having its principal office and place of business in the City of Baltimore, State of Maryland; and that the plaintiff Minerals Separation, Limited, is a corporation duly organized and existing under and by virtue of the laws of Great Britain and an inhabitant of Great Britain, having its principal office in London, England; and that on information and belief the defendant Magma Copper Company is a corporation duly organized and existing under the laws of the State of Maine and has a regular and established place of business in the City of Augusta in the State of Maine.

Second.—That this suit is brought under the Patent Laws of the United States for the infringement of United States Letters Patent No. 835,120, issued November 6, 1906, and No. 962,678, issued June 28, 1910, both for improvements in ore concentration.

Third.—That heretofore and before the thirtieth day of April, 1909, Henry Livingstone Sulman, Hugh Fitzalis Kirk-

patrick-Picard and John Ballot, all of London, England, did invent, and were the original, first and joint inventors of certain new and useful improvements in ore concentration fully described in the letters patent hereinafter mentioned, which invention had not been known or used in the United States before their invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof or more than two years prior to their application for Letters Patent of the United States hereinafter mentioned, or in public use or on sale in the United States for more than two years prior to their said application, and had not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more than twelve months prior to the filing of their said application for Letters Patent of the United States, and had not been abandoned to the public; that the said Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard and John Ballot, being as aforesaid the joint inventors of the said invention, did on the twenty-ninth day of May, 1905, make due and formal application to the Commissioner of Patents of the United States for Letters Patent of the United States therefor, in accordance with the then existing laws of the United States, and duly complied in all respects with the conditions and requirements of said laws; and thereafter, after due proceedings had, on the sixth day of November, 1906, Letters Patent of the United States numbered 835,120, all in due form of the law and bearing date the day and year last aforesaid, were duly issued and delivered to the said Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard and John Ballot, whereby there was secured to them, their executors, administrators and assigns, for the term of seventeen years from the sixth day of November, 1906, the full and exclusive right of making, using and selling the said improvements in ore concentration shown, described and claimed in said letters patent, throughout the United States and in the territories thereof, which letters patent are now of record in the United States Patent Office, and which, or a duly

certified copy thereof, the plaintiffs will produce as the Court may direct.

Fourth.—That on or about the seventh day of December, 1909, the said Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard and John Ballot, by an instrument in writing duly executed and delivered by them and bearing date the last-named day, assigned and transferred to the plaintiff, Minerals Separation, Limited, all right, title and interest in and to the said invention and Letters Patent No. 835,120, and that the said instrument in writing was duly recorded in the Patent Office of the United States on or about the twenty-eighth day of August, 1911, all of which will more fully appear by the said instrument in writing with the certificate of the Commissioner of Patents ready in court to be produced as the Court may direct.

Fifth.—That heretofore and before the thirtieth day of April, 1909, Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, all of London, England, did invent, and were the original first and joint inventors of certain new and useful improvements in ore concentration fully described in the letters patent hereinafter mentioned, which invention had not been known or used in the United States before their invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof or more than two years prior to their application for Letters Patent of the United States hereinafter mentioned, or in public use or on sale in the United States for more than two years prior to their said application, and had not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more than twelve months prior to the filing of their said application for Letters Patent of the United States, and had not been abandoned to the public; that the said Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, being as aforesaid the joint inventors of the said invention, did on

the thirtieth day of April, 1909, make due and formal application to the Commissioner of Patents of the United States for Letters Patent of the United States therefor, in accordance with the then existing laws of the United States, and duly complied in all respects with the conditions and requirements of said laws; and thereafter, after due proceedings had, on the twenty-eighth day of June, 1910, Letters Patent of the United States numbered 962,678, all in due form of the law and bearing date the day and year last aforesaid, were duly issued and delivered to the said Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, whereby there was secured to them, their executors, administrators and assigns, for the term of seventeen years from the twenty-eighth day of June, 1910, the full and exclusive right of making, using and selling the said improvements in ore concentration shown, described and claimed in said letters patent, throughout the United States and in the territories thereof, which letters patent are now of record in the United States Patent Office, and which, or a duly certified copy thereof, the plaintiffs will produce as the Court may direct.

Sixth.—That the said Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, by an instrument in writing duly made and executed, assigned and transferred to the plaintiff, Minerals Separation, Limited, all right, title and interest in and to the said invention and Letters Patent No. 962,678, and that the said instrument in writing was duly recorded in the Patent Office of the United States on or about the twenty-eighth day of August, 1911, all of which will more fully appear by the said instrument in writing with the certificate of the Commissioner of Patents ready in Court to be produced as the Court may direct.

Seventh.—That by an instrument in writing dated the eighth day of July, 1913, which, or a duly certified copy thereof, the plaintiffs will produce as the Court may direct, Minerals Separation, Limited, plaintiff, entered into an agreement of sale and purchase with Minerals Separation Ameri-

can Syndicate (1913), Limited, a corporation duly organized and existing under and by virtue of the laws of Great Britain, by which Minerals Separation, Limited, agreed to sell and Minerals Separation American Syndicate (1913), Limited, agreed to purchase (along with other things) the entire beneficial interest in the said Letters Patent Nos. 835,120 and 962,678, the purchase to be completed on or before the tenth day of October, 1913: that by mutual arrangement the completion of the purchase by the assignment of the said Letters Patent Nos. 835,120 and 962,678 (and others) was deferred pending the litigation against James M. Hyde, hereinafter referred to, and other litigation; that by mutual arrangement the completion of the payment of the full consideration to Minerals Separation, Limited, plaintiff, was deferred until on or about the sixth day of October, 1916, and thereupon the entire beneficial interest in said Letters Patent Nos. 835,120 and 962,678 vested in said Minerals Separation American Syndicate (1913), Limited; that by an instrument in writing dated the seventh day of December, 1916 (which or a duly certified copy thereof the plaintiffs will produce as the Court may direct), Minerals Separation American Syndicate (1913), Limited, sold, assigned and transferred to Minerals Separation North American Corporation, plaintiff, all the right, title and interest in and to said Letters Patent Nos. 835,120 and 962,678 to which it then was, or might thereafter become, entitled, and all moneys due or to grow due, royalties due or to grow due, claims and demands and things in action, of Minerals Separation American Syndicate (1913), Limited; that by virtue of the premises the plaintiffs became and now are the sole owners of said Letters Patent Nos. 835,120 and 962,-678 and of all of the claims and demands and rights of action for profits and damages for infringements of said Letters Patent from the tenth day of October, 1913.

Eighth.—That the said inventions described in said Letters Patent Nos. 835,120 and 962,678 are capable of conjoint use and have been so used by plaintiffs and their licensees and have been so used by defendant; and that the said inven-

tions are of great value and utility to plaintiffs and to the public generally and that the plaintiffs have made the said inventions profitable to themselves and to the public by careful and elaborate tests of said inventions in their application to a wide variety of ores and by the extensive commercial use of the said inventions by plaintiffs and their licensees in different parts of the world, including the United States, Australia, South America, Europe, Africa and Canada; and that the plaintiffs have granted numerous licenses in the United States and elsewhere for carrying on the process of ore concentration constituting such inventions; and that the plaintiffs are able and willing to supply the entire demand for the use of said inventions throughout the United States particularly by granting licenses for the use of same conditioned under payment of royalties measured by the output of said processes of concentration and that the plaintiffs will realize and receive large gains and profits from the said inventions if infringement by defendant and its confederates shall be prevented.

Ninth.—That in the suit of Minerals Separation, Limited, and another, against James M. Hyde, for infringement of said Letters Patent No. 835,120 brought in the District Court of the United States for the District of Montana on or about October 9, 1911, and terminated by a mandate of the Supreme Court of the United States issued on the thirteenth day of January, 1917, and final decree on mandate entered on the sixteenth day of April, 1917, claims 1, 2, 3, 5, 6, 7 and 12 of said Letters Patent No. 835,120 were held valid and infringed and claims 9, 10 and 11 invalid, as appears by the opinion and mandate of the Supreme Court filed in that case and final decree of the District Court entered thereon, certified copies of which are ready to be produced as the Court may direct.

Tenth.—That on the twenty-eighth day of March, 1917, Minerals Separation, Limited, plaintiff, as the sole assignee, at law, of the patentees of said Letters Patent No. 835,120 for the whole of the United States and the territories and pos-

sessions thereof, in view of the aforesaid decision and mandate of the Supreme Court of the United States and under and pursuant to the laws for such cases made and provided and without unreasonable neglect or delay, entered its disclaimer to so much of the thing patented by claims 9, 10 and 11 of said Letters Patent No. 835,120 as it did not choose to hold or claim by virtue of said letters patent, all as appears by said disclaimer, a certified copy of which is ready here in court to be produced as the Court may direct; that the processes recited in claims 9, 10 and 11 of said Letters Patent No. 835,120 as limited by said disclaimer were new and original inventions of the patentees thereof and a material and substantial part of the thing patented and definitely distinguishable from the parts claimed without right, and that said claims 9, 10 and 11 of said Letters Patent No. 835,120 as limited by said disclaimer are good and valid in law.

Eleventh.—That in the suit of Minerals Separation, Limited, and Minerals Separation North American Corporation, plaintiffs, and another, against Butte & Superior Mining Company, designated as Butte & Superior Copper Company, Limited, brought in the District Court of the United States of the District of Montana, on or about October 10, 1913, and terminated as to the merits by a mandate of the Supreme Court of the United States issued on the twenty-fifth day of June, 1919, and interlocutory decree of the District Court on said mandate entered on the nineteenth day of July, 1919, claims 1, 2, 3, 5, 6, 7 and 12 of said Letters Patent No. 835,120 and claims 9, 10 and 11 thereof as limited by the aforesaid disclaimer were held good and valid in law and infringed, as appears by the opinion and mandate of the Supreme Court filed in that case and the interlocutory decree of the District Court entered on said mandate and the opinion of the District Court on the settlement of said interlocutory decree, certified copies of which are ready to be produced as the Court may direct.

Twelfth.—That in the suit of Minerals Separation, Limited, plaintiff, against Miami Copper Company, for infringe-

ment of Letters Patent Nos. 835,120 and 962,678 and another letters patent, brought in the District Court of the United States for the District of Delaware on or about October 10, 1914, and terminated as to the merits by mandates of the United States Circuit Court of Appeals for the Third Circuit issued on the twenty-seventh day of August, 1917, and interlocutory decree of the District Court on said mandates entered on the eighth day of September, 1917, claims 1 and 12 of said Letters Patent No. 835,120 and claims 1, 2, 5 and 6 of said Letters Patent No. 962,678 were held valid and infringed, as appears by the opinion and mandates of the United States Circuit Court of Appeals for the Third Circuit, filed in that case, and interlocutory decree of the District Court entered thereon, certified copies of which are ready to be produced as the Court may direct.

Thirteenth.—That defendant, well knowing the premises and the rights secured to the plaintiffs as aforesaid and contriving to injure the plaintiffs and to deprive them of the benefits and advantages from said inventions and letters patent, did, after the respective dates of the issuance of said letters patent and before commencement of this suit and within six years prior to commencement of this suit, as the plaintiffs are informed and believe, without the license or allowance and against the will of the plaintiffs, and in violation of their rights and in infringement of the aforesaid Letters Patent Nos. 835,120 and 962,678 unlawfully and wrongfully in Pinall County, in the State of Arizona, and elsewhere in the United States of America, install apparatus for and carry on the use of the said processes of ore concentration as described in the specifications and pointed out and claimed in claims 1, 2, 3 and 12 of the aforesaid Letters Patent No. 835,120 and in claims 9, 10 and 11 of said Letters Patent No. 835,120 as limited by the aforesaid disclaimer, and in claims 1, 2, 3, 4, 5, 6, 7 and 8 of the aforesaid Letters Patent No. 962,678, and in such infringement did during certain periods conjointly use in one process both of said inventions, and during certain other periods did separately use the invention of said Letters Patent No. 962,678, all in infringement of the plaintiffs' rights

under the said letters patent, whereby plaintiffs have been and still are being greatly damaged and deprived of gains and profits that they might and otherwise would have obtained and which have been realized and enjoyed by the said defendant by and through the aforesaid unlawful acts and doings.

Fourteenth.—On information and belief, that the said defendant has made and received profits and advantages from the infringement of said letters patent as aforesaid, but to what extent and how much exactly plaintiffs do not know and pray a discovery thereof.

Fifteenth.—That the installation and use of said inventions by the said defendant and its other unlawful acts in disregard and in defiance of the rights of the plaintiffs have the effect of aiding, encouraging and inducing others so to venture to infringe said letters patent in disregard of the plaintiffs' rights.

Sixteenth.—That the defendant has been repeatedly duly notified of infringement of said Letters Patent Nos. 835,120 and 962,678, and that such notice was orally repeated and conversations entered into relative thereto shortly prior to the commencement of this suit, and further that defendant has been fully informed of the rights of plaintiffs in the premises, not only by reason of the great publicity given to the plaintiffs' rights and the litigations thereon and the general knowledge of the granting of licenses in the United States under said letters patent, but also by reason of the installation and extensive use of the said inventions under license in mines and in places accessible to the defendant and its representatives and with the full knowledge of defendant which has in fact copied the procedure thus carried on by licensees of the plaintiffs.

And inasmuch as the plaintiffs cannot have adequate relief except in this Court and to the end that the defendant may, if it can, show cause why plaintiffs should not have the relief herein prayed for and may, but not upon oath (an oath

to defendant's answer being hereby waived) according to its best knowledge, remembrance, information and belief, full, true, direct and perfect answer make to all and singular the premises, and that the said defendant may be compelled to account for and pay to the plaintiffs the profits thus unlawfully derived or which might have been derived from the violation of the rights of the plaintiffs aforesaid as well as the damages therefor, and be restrained from any further violation of said rights, the plaintiffs pray that your Honors may grant a writ of injunction restraining defendant, its officers, associates, servants, agents, attorneys, clerks and workmen and every person acting for or on behalf of said defendant, from any installation or use in any manner of the said patented inventions, or any part thereof, in violation of the rights of plaintiffs as aforesaid, and from otherwise infringing in any manner directly or indirectly upon the rights of the plaintiffs aforesaid; and also that your Honors, upon the entering of a decree for infringement, as above prayed for, may proceed to assess or cause to be assessed under your Honors' direction in addition to the gains and profits to be accounted for by the defendant, the damages plaintiffs have sustained by reason of said infringement.

And the plaintiffs pray also for a provisional or preliminary injunction during the pendency of this suit to the same purport and effect as hereinbefore prayed for in regard to a perpetual injunction and that the defendant may be decreed to pay the costs of this suit; and for such further and other relief as the equity of the case may require and as to your Honors may seem meet.

May it please your Honors to grant to the plaintiffs a writ of injunction conformable to the prayer of this bill and also a writ of subpoena issuing out of and under the seal of this Honorable Court directed to said defendant, Magma Copper Company, commanding it by a certain day and under a certain penalty to appear before this Honorable Court, then and there to answer the plaintiffs and to abide by and per-

form such orders and decrees in the premises as to the Court shall seem meet and be required by the principles of equity and good conscience.

And the plaintiffs will ever pray, etc.

MINERALS SEPARATION, LIMITED,
By JOHN BALLOT,
Director.

HENRY D. WILLIAMS,
WM. HOUSTON KENYON,
LINDLEY M. GARRISON,
Of Counsel for Plaintiffs.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
By JOHN BALLOT,
President.

Solicitor and of Counsel for Plaintiffs.

UNITED STATES OF AMERICA,
STATE OF NEW YORK,
COUNTY OF NEW YORK, } *ss.:*

JOHN BALLOT, being duly sworn, deposes and says that he is the President of Minerals Separation North American Corporation, and a director of Minerals Separation, Limited, the plaintiffs named in the foregoing bill of complaint, that he has read the same and knows the contents thereof, and that the same is true of his own knowledge except as to matters therein alleged to be stated on information and belief and as to those matters he believes it to be true.

JOHN BALLOT.

Sworn to and subscribed before me this eighth day of January, 1920.

HARRY C. LEWIS,
Notary Public, N. Y. County No. 281.

IN THE DISTRICT COURT OF THE UNITED STATES DISTRICT OF MAINE, SOUTHERN DIVISION.

Minerals Separation North American Corporation and Minerals Separation, Limited,

Plaintiffs,

v.

Magma Copper Company,

Defendant.

IN EQUITY ON LETTERS PATENT NOS. 835,120 AND 962,678.

DEFENDANT'S ANSWER.

The Magma Copper Company for answer to the plaintiffs' bill of complaint says:

I. The defendant is a corporation organized under the laws of the State of Maine and has its principal legal office in Augusta, Maine; the defendant is not informed and therefore denies that the plaintiff Minerals Separation North American Corporation is a corporation organized or existing under the laws of the State of Maryland, or has its principal office or place of business in Baltimore, Maryland; and that the plaintiff Minerals Separation, Limited, is a corporation organized or existing under the laws of Great Britain, or is an inhabitant of Great Britain, or has its principal office in London, England, and leaves the plaintiffs to make such proof thereof as they may be advised.

II. The defendant admits that Letters Patent of the United States No. 835,120 were issued on November 6, 1906, to Henry Livingston Sulman, Hugh Fitzalis Kirkpatrick-Picard and John Ballot, but on information and belief, the defendant denies that before the thirtieth day of April, 1909, (as alleged in the bill of complaint) and that before the twenty-ninth day

of May, 1905, or at any other time, Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard and John Ballot did invent or were the original or first or joint inventors of new and useful improvements in ore concentration described in said letters patent; and on information and belief, the defendant denies all the other allegations of the third paragraph of the bill of complaint.

III. As to the matters and things alleged in the fourth paragraph of the bill of complaint, the defendant is not informed, and, therefore, denies the same, demands the production at or before the trial of the instruments in writing referred to, and leaves the plaintiffs to make such proof of said allegations as they may be advised.

IV. The defendant admits that Letters Patent of the United States No. 962,678 were issued on June 28, 1910, to Henry Livingston Sulman, Henry Howard Greenway and Arthur Howard Higgins; but on information and belief, the defendant denies all the other allegations of the fifth paragraph of the bill of complaint.

V. As to the matters and things alleged in the sixth and seventh paragraphs of the bill of complaint, the defendant is not informed and therefore denies the same, demands the production at or before the trial of the instruments in writing referred to, and leaves the plaintiffs to make such proof of said allegations as they may be advised.

VI. The defendant denies that it has ever used, either separately or conjointly, the alleged inventions described in the Letters Patent No. 835,120 and No. 962,678, or either of them; it admits the value and utility of the alleged invention described in the said Letters Patent No. 835,120, but it denies that the alleged invention described in the said Letters Patent No. 962,678 has any value or utility whatever, the defendant, not having used either of said inventions, either singly or conjointly, is not informed as to whether they are capable of conjoint use and therefore denies that allegation and leaves

the plaintiffs to make such proof thereof as they may be advised, and denies that the plaintiffs have made the alleged inventions profitable to themselves and to the public by careful and elaborate tests of said alleged inventions in their application to a wide variety of ores, but, on the contrary, the defendant alleges that accredited representatives and agents of the plaintiff, Minerals Separation, Limited, did, on various occasions, orally and in writing, assert that said inventions could not be adapted to the ores such as defendant's ore; and the defendant is not informed whether the plaintiffs are able or willing to supply the entire demand for the use of said alleged inventions throughout the United States, by granting licenses or otherwise, and it, therefore, denies that allegation and leaves the plaintiffs to make such proof thereof as they may be advised, but the defendant denies that plaintiffs are ready and willing to grant licenses for the use of said alleged inventions conditioned only upon the payment of royalties measured by the output of said processes of concentration, but, on the contrary, avers that the plaintiffs insist upon restrictive terms and conditions of license which have nothing to do with the processes of concentration described in the said patents, which are grossly unfair, and which unlawfully restrict the commercial freedom of their licensees; and the defendant further denies that the prevention or continuation of any act of its will in anywise affect the realization or receipt of large or any gains or profits from the said inventions by the plaintiffs.

VII. The defendant is familiar with the published decisions of the Supreme Court in the suit of Minerals Separation, Limited, and another, against Hyde, and in the suit of Minerals Separation, Limited, and Minerals Separation North American Corporation, and another, against Butte & Superior Mining Company, and with the published decision of the Circuit Court of Appeals of the Third Circuit in the suit of Minerals Separation, Limited, against Miami Copper Company referred to in the ninth, eleventh and twelfth paragraphs of the bill of complaint, and it admits the existence of those suits and that those decisions have been rendered,

and it accepts the decisions of the Supreme Court in the Hyde case and the Butte case as authoritative adjudications of the validity and scope of the agitation froth flotation process Patent No. 835,120, but it avers that by the force of those decisions, and by the proceedings conducted on behalf of the applicants for the said patent in the Patent Office, the plaintiffs are estopped to ask for any interpretation of the claims of said patent or any of them sufficiently broad to include the pneumatic flotation process used by the defendant, and it further avers that any such broad interpretation of the claims of the said patent would render the said claims invalid and void in view of the prior art which this defendant is ready to aver, maintain and prove, and the defendant does not accept as authoritative or binding upon this Court the decision of the Circuit Court of Appeals of the Third Circuit in the Miami case, and particularly with respect to the soluble frothing agent Patent No. 962,678; the defendant controverts the decision and avers that the said patent is wholly invalid and void.

With respect to the allegations of the tenth paragraph of the bill of complaint, the defendant admits that the plaintiffs, Minerals Separation, Limited, filed a paper in the Patent Office which was called a disclaimer with respect to claims 9, 10 and 11 of said Patent No. 835,120, but it avers that the said alleged disclaimer was not a disclaimer in law or in fact within the provisions of the statutes in such cases made and provided, and it avers that the plaintiffs have unreasonably neglected and delayed to enter a proper disclaimer with respect to those claims.

VIII. The defendant denies that in Pinall County, in the State of Arizona, or anywhere else in the United States of America, it has ever installed apparatus for or carried on the use of the processes of ore concentration described in the specifications and pointed out and claimed in claims 1, 2, 3 and 12 of Letters Patent No. 835,120 and in claims 9, 10 and 11 of said patent as limited by the aforesaid alleged disclaimer, or in claims 1, 2, 3, 4, 5, 6, 7 and 8 of the aforesaid

Letters Patent No. 962,678, or any of those claims, or of any part of said processes, either separately or conjointly, but, on the contrary, it avers that the pneumatic flotation process employed by it is a process protected by United States Letters Patent under which the defendant is licensed, which process is entirely different and distinct from any invention described or claimed in either of plaintiffs' patents, No. 835,120 or No. 962,678, and it denies all the other allegations of the thirteenth, fourteenth and fifteenth paragraphs of the said bill of complaint.

IX. The defendant denies that it has been duly notified of the infringement of said letters patent or either of them in accordance with the requirements of the revised statutes of the United States; it has no knowledge of the character or substance of the alleged oral notice or conversations referred to in the sixteenth paragraph of the bill of complaint, and therefore denies the same and leaves the plaintiffs to make such proof thereof as they may be advised, and it denies that it is informed of any rights of the plaintiffs, as referred to in the sixteenth paragraph of the bill of complaint, by reason of publicity given to the plaintiffs' alleged rights, or the alleged litigation thereof, or by the alleged general knowledge of the granting of licenses in the United States under the said letters patent, or by the installation or extensive use of the alleged inventions under license in mines or places alleged to be accessible to the defendant or its representatives, and it denies that it has copied any procedure carried on by licensees of the plaintiffs.

X. Defendant further answering, on information and belief, avers that the said Patent No. 962,678 is invalid and void and of no force and effect for the following reasons; to wit,

(a) That the patentees, Sulman, Greenway and Higgins, were not the original and first inventors or discoverers of that which is patented by said letters patent, or any material or substantial part thereof, but that, on the contrary, prior to the alleged invention or discovery

of said patentees, the things patented by said patent and all material and substantial parts thereof have been,

1. Patented and published in each of the following letters patent:

UNITED STATES PATENTS.

No.	Date	Patentee
703,905	July 1, 1902	Elmore
735,071	Aug. 4, 1903	Delprat
763,260	June 21, 1904	Cattermole
768,035	Aug. 23, 1904	Delprat
776,145	Nov. 29, 1904	Potter
777,273	Dec. 13, 1904	Cattermole
777,274	Dec. 13, 1904	Cattermole
788,247	Apr. 25, 1905	Cattermole, Sulman & Picard
793,808	July 4, 1905	Sulman & Picard
805,382	Nov. 21, 1905	Sanders
826,411	July 17, 1906	Elmore
835,120	Nov. 6, 1906	Sulman, Picard & Ballot
879,985	Feb. 25, 1908	Sulman, Picard & Ballot

BRITISH PATENTS

17109 of 1903	Cattermole
19783 of 1903	Delprat
27132 of 1903	Delprat
17816 of 1904	Elmore
5953 of 1905	Elmore
7803 of 1905	Sulman, Picard & Ballot
15119 of 1905	MacQuisten
26264 of 1908	Lockwood & Samuel

AUSTRALIAN PATENTS

1935 of 1904	Elmore

GERMAN PATENTS

42 of 1877	Bessel
39369 of 1887	Bessel

Also patented or described and contained in other letters patent, the dates, numbers and grantees of which this defend-

ant is not now able to specify, but prays to be allowed hereafter to add by amendment to this answer, or otherwise.

2. Described in the following printed publications:

The Mining Journal (London), May 11, 1907, Page 623;

The Engineering and Mining Journal (New York City), June 1, 1907, Page 1037;

The Engineer (London), May 10, 1907, Page 469.

Also illustrated or described in other printed publications, the names and dates of which this defendant is not now able to specify but prays to be allowed hereafter to add by amendment to this answer, or otherwise.

3. Known to various persons, the names and addresses of whom the defendant is not now able to give, but hopes to be allowed hereafter to add by amendment to this answer.

(b) That the state of the art prior to the alleged invention or discovery of the said Patent No. 962,678 was such that there was no patentable novelty in the subject matter described in said patent and claimed in claims 1, 2, 3, 4, 5, 6, 7 and 8 thereof, which state of the art the defendant is ready to aver, maintain and prove.

(c) That the patentees Sulman, Greenway and Higgins were not joint inventors of the subject matter alleged to be patented by said letters patent or any substantial or material part thereof.

(d) That the specifications and claims of the said patent do not constitute a full, clear, concise or exact description of the alleged invention or of the manner or process of making, constructing, compounding or using it in accordance with the statutes in such cases made and provided, nor do they particularly point out or distinctly claim the part, improvement or combination which the inventors claim as their invention or discovery; but on the contrary, said specification, as the defendant avers, was deliberately, and for the purpose of deceiving the Patent Office and the public, made to contain less than a complete description of the invention and the said claims for the same purpose were made to claim more than had been invented by the said inventors either jointly or severally.

XI. The defendant further avers, on information and belief, that in view of the state of the art prior to the alleged invention of the said Letters Patent No. 835,120 and No. 962,678 the claims thereof, regardless of their language, to be sustained as valid must be so construed as not to cover any process of ore concentration heretofore or now carried on by the defendant.

XII. The defendant further avers, upon information and belief, that by reason of the acts done by the applicants, the plaintiffs are now estopped from alleging that the claims of said Letters Patent No. 835,120 and No. 962,678 or any of them, can be construed to cover any process of ore concentration practiced by the defendant.

XIII. The defendant further answering denies the equity of the plaintiffs' bill of complaint and avers that the plaintiffs are not entitled to an injunction nor to an account of profits, nor to damages, nor to any royalty or recovery whatsoever against this defendant, as prayed in the said bill of complaint.

All of which matters and things, this defendant is ready to aver, maintain and prove as this Honorable Court shall direct, and prays that the bill of complaint be dismissed, and that the defendant shall recover its costs and disbursements in this suit.

MAGMA COPPER COMPANY,
(Seal) By (Signed) H. E. DODGE,
Secretary.

(Signed) JOHN C. PENNIE,
(Signed) WOODMAN & WHITEHOUSE,
Of Counsel.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY.

Minerals Separation North American Corporation and Minerals Separation, Ltd.

Plaintiffs,

v.

Magma Copper Company,

Defendant.

ORDER.

Upon reading and filing the annexed stipulation and supplemental and amended bill of complaint, it is hereby

ORDERED that the bill of complaint herein be dismissed with respect to Letters Patent No. 835,120, without prejudice, and that Minerals Separation North American Corporation, plaintiff, have leave to file said supplemental and amended bill of complaint, and that the entry and filing of this order with annexed supplemental and amended bill of complaint shall constitute the filing of said supplemental and amended bill of complaint.

The parties having waived the issuance of a writ of subpoena the defendant is hereby ordered to file its answer or other defense to the said supplemental and amended bill of complaint on or before the twentieth day after filing thereof.

JOHN H. PETERS,
United States District Judge.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY.

Minerals Separation North American Corporation and Minerals Separation, Ltd.,

Plaintiffs,

v.

Magma Copper Company,

Defendant.

STIPULATION.

IT IS HEREBY STIPULATED AND AGREED by and between counsel for the parties to the above-entitled suit that the bill of complaint herein may be dismissed with respect to Letters Patent No. 835,120, without prejudice, and that the supplemental and amended bill of complaint hereto annexed may be filed in this suit, and that an order in the form hereto annexed may be entered without further notice to either side.

IT IS FURTHER STIPULATED AND AGREED that the issuance of a writ of subpoena upon the filing of such supplemental and amended bill be and the same hereby is waived and that the defendant file its answer to such supplemental and amended bill within twenty days from the date of filing of such supplemental and amended bill.

HENRY D. WILLIAMS,
WM. H. KENYON,
LINDLEY M. GARRISON,
Counsel for Plaintiffs.

PENNIE, DAVIS MARVIN & EDMONDS,
Counsel for Defendant.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

SUPPLEMENTAL AND AMENDED BILL OF COMPLAINT.

Now comes Minerals Separation North American Corporation, the plaintiff above named, and, with leave of Court first had and received, files this, its supplemental and amended bill of complaint and alleges by way of amendment and supplement:

That heretofore, to wit, on the ninth day of January, 1920, Minerals Separation North American Corporation and Minerals Separation, Limited, filed their bill of complaint in this court, alleging the issuance and their ownership of Letters Patent Nos. 835,120 and 962,678 and infringement by the above-named defendant and praying for an injunction and accounting of profits and damages; and that the said defendant filed an answer thereto. Reference is here made to said bill and answer for a more complete statement of the contents thereof. That thereafter, pending trial of the issue thereby raised, Minerals Separation North American Corporation became vested with the entire right, title and interest in and to the said letters patent and in and to all right of action, claim and demand for past infringement thereof, by virtue of an assignment in writing from Minerals Separation, Limited, as hereinafter more fully recited, and that Minerals Separation,

Limited, thereupon and thereby became divested of all right, title and interest in and to the said letters patent and in and to the cause of complaint herein.

WHEREFORE, the plaintiff, Minerals Separation North American Corporation, now and hereby amends and supplements the said bill of complaint filed on the ninth day of January, 1920, to read as follows, and alleges:

First.—That the plaintiff Minerals Separation North American Corporation is a corporation duly organized and existing under and by virtue of the laws of the State of Maryland having its principal office and place of business in the City of Baltimore, State of Maryland; and that on information and belief the defendant Magma Copper Company is a corporation duly organized and existing under the laws of the State of Maine and has a regular and established place of business in the City of Augusta in the State of Maine.

Second.—That this suit is brought under the patent laws of the United States for the infringement of United States Letters Patent No. 962,678, issued June 28, 1910, for improvements in ore concentration.

Third.—That heretofore and before the thirtieth day of April, 1909, Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, all of London, England, did invent, and were the original first and joint inventors of, certain new and useful improvements in ore concentration fully described in the letters patent hereinafter mentioned, which invention had not been known or used in the United States before their invention or discovery thereof, or patented or described in any printed publication in any country before their invention or discovery thereof or more than two years prior to their application for Letters Patent of the United States hereinafter mentioned, or in public use or on sale in the United States for more than two years prior to their said application, and had

not been patented in any country foreign to the United States on an application filed by them or their legal representatives or assigns more than twelve months prior to the filing of their said application for Letters Patent of the United States, and had not been abandoned to the public; that the said Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, being as aforesaid the joint inventors of the said invention, did on the thirtieth day of April, 1909, make due and formal application to the Commissioner of Patents of the United States for Letters Patent of the United States therefor, in accordance with the then existing laws of the United States, and duly complied in all respects with the conditions and requirements of said laws; and thereafter, after due proceedings had, on the twenty-eighth day of June, 1910, Letters Patent of the United States numbered 962,678, all in due form of the law and bearing date the day and year last aforesaid, were duly issued and delivered to the said Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, whereby there was secured to them, their executors, administrators and assigns, for the term of seventeen years from the twenty-eighth day of June, 1910, the full and exclusive right of making, using and selling the said improvements in ore concentration shown, described and claimed in said letters patent, throughout the United States, and in the territories thereof, which letters patent are now of record in the United States Patent Office, and which, or a duly certified copy thereof, the plaintiff will produce as the Court may direct.

Fourth.—That the said Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, by an instrument in writing duly made and executed, assigned and transferred to Minerals Separation, Limited, all right, title and interest in and to the said invention and Letters Patent No. 962,678, and that the said instrument in writing was duly recorded in the Patent Office of the United States on or about the twenty-eighth day of August, 1911, all of

which will more fully appear by the said instrument in writing with the certificate of the Commissioner of Patents ready in court to be produced as the Court may direct.

Fifth.—That the said Minerals Separation, Limited, by an instrument in writing executed and acknowledged on the first day of June, 1922, duly sold, assigned and transferred the whole right, title and interest, together with all right of action, claim and demand for past infringement in and to said Patent No. 962,678, to the plaintiff Minerals Separation North American Corporation, and the said instrument in writing was duly recorded in the Patent Office of the United States on or about the twenty-first day of June, 1922, all of which will more fully appear by the said instrument in writing with the certificate of the Commissioner of Patents ready in court to be produced as the Court may direct.

Sixth.—That the said invention described in said Letters Patent No. 962,678 is of great value and utility to plaintiff and to the public generally and that the plaintiff has made the said invention profitable to itself and to the public by careful and elaborate tests of said invention in its application to a wide variety of ores and by the extensive commercial use of the said invention by plaintiff and its licensees and that the plaintiff has granted numerous licenses in the United States and elsewhere for carrying on the process of ore concentration constituting such invention; and that the plaintiff is able and willing to supply the entire demand for the use of said invention throughout the United States particularly by granting licenses for the use of same conditioned under payment of royalties measured by the output of said process of concentration, and that the plaintiff will realize and receive large gains and profits from the said invention if infringement by defendant and its confederates shall be prevented.

Seventh.—That in the suit of Minerals Separation, Limited, plaintiff, against Miami Copper Company, for infringement of Letters Patent No. 962,678 and two other

letters patent, brought in the District Court of the United States for the District of Delaware on or about October 10, 1914, and terminated as to the merits by mandates of the United States Circuit Court of Appeals for the Third Circuit issued on the twenty-seventh day of August, 1917, and interlocutory decree of the District Court on said mandates entered on the eighth day of September, 1917, claims 1, 2, 5 and 6 of said Letters Patent No. 962,678 were held valid and infringed, as appears by the opinion and mandates of the United States Circuit Court of Appeals for the Third Circuit, filed in that case, and interlocutory decree of the District Court entered thereon, certified copies of which are ready to be produced as the Court may direct.

Eighth.—That defendant, well knowing the premises and the rights secured to the plaintiff as aforesaid and contriving to injure the plaintiff and to deprive it of the benefits and advantages from said invention and letters patent, did, after the date of the issuance of said letters patent and before commencement of this suit and within six years prior to commencement of this suit, as the plaintiff is informed and believes, without the license or allowance and against the will of the plaintiff, and in violation of its rights and in infringement of the aforesaid Letters Patent No. 962,678, unlawfully and wrongfully, in Pinall County in the State of Arizona and elsewhere in the United States of America, install apparatus for and carry on the use of the said process of ore concentration as described in the specification and pointed out and claimed in claims 1, 2, 3, 4, 5, 6, 7 and 8 of the aforesaid Letters Patent No. 962,678, and in such infringement did use the invention of said Letters Patent No. 962,678, all in infringement of the plaintiff's rights under the said letters patent, whereby plaintiff has been and still is being greatly damaged and deprived of gains and profits that it might and otherwise would have obtained and which have been realized and enjoyed by the said defendant by and through the aforesaid unlawful acts and doings.

Ninth.—On information and belief, that the said defendant has made and received profits and advantages from the infringement of said letters patent as aforesaid, but to what extent and how much exactly plaintiff does not know and prays a discovery thereof.

Tenth.—That the installation and use of said invention by the said defendant and its other unlawful acts in disregard and in defiance of the rights of the plaintiff have the effect of aiding, encouraging and inducing others so to venture to infringe said letters patent in disregard of the plaintiff's rights

Eleventh.—That the defendant has been repeatedly duly notified of infringement of said Letters Patent No. 962,678, and that such notice was orally repeated and conversations entered into relative thereto shortly prior to the commencement of this suit, and further that defendant has been fully informed of the rights of plaintiff in the premises, not only by reason of the great publicity given to the plaintiff's rights and the litigations thereon and the general knowledge of the granting of licenses in the United States under said letters patent, but also by reason of the installation and extensive use of the said invention under license in mines and in places accessible to the defendant and its representatives and with the full knowledge of defendant which has in fact copied the procedure thus carried on by licensees of the plaintiff.

And inasmuch as the plaintiff cannot have adequate relief except in this Court and to the end that the defendant may, if it can, show cause why plaintiff should not have the relief herein prayed for and may, but not upon oath (an oath to defendant's answer being hereby waived) according to its best knowledge, remembrance, information and belief, full, true, direct and perfect answer make to all and singular the premises, and that the said defendant may be compelled to account for and pay to the plaintiff the profits thus unlawfully derived or which might have

been derived from the violation of the rights of the plaintiff aforesaid as well as the damages therefor, and be restrained from any further violation of said rights, the plaintiff prays that your Honors may grant a writ of injunction restraining defendant, its officers, associates, servants, agents, attorneys, clerks and workmen and every person acting for or on behalf of said defendant, from any installation or use in any manner of the said patented invention, or any part thereof, in violation of the rights of plaintiff as aforesaid, and from otherwise infringing in any manner directly or indirectly upon the rights of the plaintiff aforesaid; and also that your Honors, upon the entering of a decree for infringement, as above prayed for, may proceed to assess or cause to be assessed under your Honors direction in addition to the gains and profits to be accounted for by the defendant, the damages plaintiff has sustained by reason of said infringement.

And the plaintiff prays also for a provisional or preliminary injunction during the pendency of this suit to the same purport and effect as hereinbefore prayed for in regard to a perpetual injunction and that the defendant may be decreed to pay the costs of this suit; and for such further and other relief as the equity of the case may require and as to your Honors may seem meet.

And the plaintiff will ever pray, etc.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
By Seth Gregory,
President.

Henry D. Williams,
Wm. Houston Kenyon,
Lindley M. Garrison,
of Counsel for Plaintiff.

Sidney St. F. Thaxter,
Solicitor and of Counsel for Plaintiff.

UNITED STATES OF AMERICA,
STATE OF NEW YORK,
COUNTY OF NEW YORK, } *ss.:*

SETH GREGORY being duly sworn deposes and says that he is the President of Minerals Separation North American Corporation, the plaintiff named in the foregoing bill of complaint, that he has read the same and knows the contents thereof, and that the same is true of his own knowledge except as to matters therein alleged to be stated on information and belief, and as to those matters he believes it to be true.

SETH GREGORY.

Sworn to and subscribed before me this 17th day of July, 1922.

(Seal) F. L. REQUA,
Notary Public, N. Y. County, No. 298.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

DEFENDANT'S ANSWER TO SUPPLEMENTAL AND AMENDED BILL OF COMPLAINT.

The Magma Copper Company for answer to the plaintiff's supplemental and amended bill of complaint (hereinafter referred to as the bill of complaint) says:

As to the averments contained in the introductory paragraph of the bill of complaint, the defendant admits that on or about the ninth day of January, 1920, Minerals Separation North American Corporation and Minerals Separation, Limited, filed a bill of complaint in this court, alleging the issuance and their ownership of Letters Patent Nos. 835,120 and 962,678 and infringement by the defendant and praying for an injunction and accounting of profits and damages; and that the said defendant filed an answer thereto. And the defendant, further answering the aforesaid introductory matters, avers that in its said answer defendant denies that it has ever used, either separately or conjointly, the alleged inventions described in the Letters Patent No. 835,120 and No. 962,678, or either of them; and denies that the alleged invention described in the said Letters Patent No. 962,678 has any value or utility whatever and further avers that the said Letters Patent No. 962,678 is invalid and void and of no force and effect; that thereafter, pending trial of the issues thereby

raised, the original bill of complaint was, by an order of this Honorable Court dated August —, 1922, dismissed with respect to Letters Patent No. 835,120, without prejudice. The defendant is without knowledge as to the other averments of the aforesaid introductory paragraph and therefore denies them and leaves the plaintiff to make such proof thereof as it may be advised.

1. The defendant is a corporation organized under the laws of the State of Maine and has its principal legal office in Augusta, Maine. The defendant is not informed as to the other allegations of the first and second paragraphs of the bill of complaint, and therefore denies them and leaves the plaintiff to make such proof thereof as it may be advised.

2. The defendant admits that Letters Patent of the United States No. 962,678 were issued on June 28, 1910, to Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins; but on information and belief the defendant denies all other allegations of the third paragraph of the bill of complaint.

3. The defendant is without knowledge as to the averments contained in the fourth paragraph of the bill of complaint, and therefore denies them and leaves the plaintiff to make such proof thereof as it may be advised.

4. As to the matters and things alleged in the fifth paragraph of the bill of complaint, the defendant is not informed and, therefore, denies the same, and demands the production at or before the trial of the instruments in writing referred to and leaves the plaintiff to make such proof of said matters and things as it may be advised.

5. The defendant denies that the alleged invention described in Letters Patent No. 962,678 has any value or utility whatever and denies that the plaintiff has made said alleged invention profitable to itself and to the public by careful and elaborate tests of said alleged invention in its application to a wide variety of ores and by the extensive commer-

cial use of said alleged invention by plaintiff and its licensees; and the defendant is not informed whether the plaintiff has granted numerous licenses in the United States and elsewhere for carrying on the process of ore concentration supposed to constitute said alleged invention and the defendant is not informed whether the plaintiff is able and willing to supply the entire demand for the use of said alleged invention throughout the United States by granting licenses or otherwise, and it, therefore, denies those allegations and leaves the plaintiff to make such proof thereof as it may be advised; but the defendant denies that plaintiff is ready and willing to grant licenses for the use of said alleged invention conditioned only upon the payment of royalties measured by the output of said process of concentration, but, on the contrary, avers that the plaintiff insists upon restrictive terms and conditions of license which have nothing to do with the process of concentration described in said patent, which are grossly unfair and which unlawfully restrict the commercial freedom of its licensees; and the defendant further denies that the prevention or continuation of any act of it will in any wise affect the realization or receipt of large or any gains or profits from said alleged invention by the plaintiff.

6. The defendant is familiar with the published decision of the Circuit Court of Appeals of the Third Circuit in the suit of Minerals Separation, Limited, plaintiff, against Miami Copper Company, referred to in the seventh paragraph of the bill of complaint, but the defendant does not accept as authoritative or binding upon this Court the decision of the Circuit Court of Appeals of the Third Circuit (reported in 244 Fed. Rep. 752); the Court in that case being divided and Judge Buffington dissenting from the majority opinion rendered by Judges Woolley and McPherson.

7. The defendant denies that in Pinall County, in the State of Arizona, or anywhere else in the United States of America, it has ever installed apparatus for or carried on the use of the said process of ore concentration as described in

the specification and pointed out and claimed in claims 1, 2, 3, 4, 5, 6, 7 and 8 of the aforesaid Letters Patent No. 962,678, or of any of those claims, or of any part of said process; but, on the contrary, defendant avers that the pneumatic flotation process employed by it is a process protected by United States Letters Patents under which the defendant is licensed, which process is entirely different and distinct from any process described or claimed in Letters Patent No. 962,678; and the defendant denies each and every one of the other allegations of the eighth, ninth and tenth paragraphs of the bill of complaint.

8. The defendant denies that it has been duly notified of infringement of said Letters Patent No. 962,678 in accordance with the requirements of the revised statutes of the United States; it has no knowledge of the character or substance of the alleged oral notice or conversations referred to in the eleventh paragraph of the bill of complaint, and therefore denies the same and leaves the plaintiff to make such proof thereof as it may be advised; and defendant denies that it is informed of any rights of the plaintiff, as referred to in the eleventh paragraph of the bill of complaint, by reason of publicity given to plaintiff's alleged rights, or the alleged litigation thereon, or by the alleged general knowledge of the granting of licenses in the United States under said letters patent, or by the installation and extensive use of the said alleged invention under license in mines and in places alleged to be accessible to the defendant and its representatives and of which the defendant is alleged to have full knowledge, which the defendant denies, and the defendant denies that it has copied any procedure carried on by licensees of the plaintiff.

9. Defendant further answering, on information and belief, avers that the said Letters Patent No. 962,678 is invalid and void and of no force and effect for the following reasons, to wit:

(a) That the patentees, Sulman, Greenway and Higgins, were not the original and first inventors or discoverers of that which is patented by said letters patent, or any

material or substantial part thereof, but that, on the contrary, prior to the alleged invention or discovery of said patentees, the things patented by said patent and all material and substantial parts thereof have been,

(1) Patented and published in each of the following letters patent:

UNITED STATES PATENTS.

No.	*Date.*	*Patentee.*
703,905	July 1, 1902	Elmore
735,071	Aug. 4, 1903	Delprat
763,259	June 21, 1904	Cattermole
763,260	June 21, 1904	Cattermole
768,035	Aug. 23, 1904	Delprat
776,145	Nov. 29, 1904	Potter
777,273	Dec. 13, 1904	Cattermole
777,274	Dec. 13, 1904	Cattermole
788,247	Apr. 25, 1905	Cattermole, Sulman & Picard
793,808	July 4, 1905	Sulman & Picard
805,382	Nov. 21, 1905	Sanders
807,502	Dec. 19, 1905	Schwarz
809,959	Jan. 16, 1906	Kirby
826,411	July 17, 1906	Elmore
835,120	Nov. 6, 1906	Sulman, Picard & Ballot
835,143	Nov. 6, 1906	Sulman
835,479	Nov. 6, 1906	Sulman, Picard & Ballot
865,194	Sept. 3, 1907	MacQuisten
865,195	Sept. 3, 1907	MacQuisten
879,985	Feb. 25, 1908	Sulman, Picard & Ballot
955,012	Apr. 12, 1910	Sulman

BRITISH PATENTS

17,109 of 1903	Cattermole
19,783 of 1903	Delprat
20,419 of 1903	Sulman & Picard
27,132 of 1903	Delprat
17,816 of 1904	Elmore
29,374 of 1904	Sulman & Picard

1,821 of 1905	Sulman, Picard & Ballot
5,953 of 1905	Elmore
7,803 of 1905	Sulman, Picard & Ballot
10,475 of 1905	Morgan Crucible Co. (McCourt)
15,119 of 1905	MacQuisten
8,567 of 1907	Chapman
26,264 of 1908	Lockwood & Samuel
26,852 of 1908	Minerals Separation (Higgins)
28,173 of 1908	Sulman & Picard
2,359 of 1909	Greenway, Sulman & Higgins

AUSTRALIAN PATENTS

1,935 of 1904		Elmore
13,939 of 1904	(New South Wales)	Delprat
13,940 of 1904	(New South Wales)	Delprat
6,493 of 1904	(South Australia)	Delprat
6,494 of 1904	(South Australia)	Delprat
4,128 of 1905		MacQuisten
4,655 of 1905		Sulman, Picard & Ballot
5,738 of 1906		Sulman
13,947 of 1909		Sulman, Greenway & Higgins
15,970 of 1909		Greenway
16,568 of 1909		Minerals Separation
16,601 of 1909		Sulman, Picard

GERMAN PATENTS

42 of 1877	Bessel
39,369 of 1887	Bessel
163,750 (App. filed 1904)	Cattermole, Sulman & Picard
226,096 (App. filed 1909)	Minerals Separation.

Also patented or described and contained in other letters patents, the dates, numbers and grantees of which this defendant is not now able to specify, but prays to be allowed hereafter to add by amendment to this answer, or otherwise.

(2) Described in the following printed publications:
The Mining Journal (London), May 11, 1907, page 623.

The Engineering & Mining Journal (New York City), May 11, 1907, pages 908-909.

The Engineering and Mining Journal (New York City), June 1, 1907, page 1037.

The Engineer (London), May 10, 1907, page 469.

The Engineering & Mining Journal (New York City), Feb. 16, 1907, pages 317-321.

Also illustrated or described in other printed publications, the names and dates of which this defendant is not now able to specify, but prays to be allowed hereafter to add by amendment to this answer or otherwise.

(2) Known to various persons, the names and addresses of whom the defendant is not now able to give, but prays to be allowed hereafter to add by amendment to this answer or otherwise.

(b) That the state of the art prior to the alleged invention or discovery of the said Patent No. 962,678 was such that there was no patentable novelty in the subject matter described in said patent and claimed in claims 1, 2, 3, 4, 5, 6, 7 and 8 thereof, which state of the art the defendant is ready to aver, maintain and prove.

(c) That the patentees Sulman, Greenway and Higgins were not joint inventors of the subject matter alleged to be patented by said Letters Patent No. 962,678 or any substantial or material part thereof.

(d) That the specification and claims of the said Letters Patent No. 962,678 do not constitute a full, clear, concise or exact description of the alleged invention or of the manner or process of making, constructing, compounding or using it in accordance with the statutes in such cases made and provided, nor do they particularly point out or distinctly claim the part, improvement or combination which the patentees claim as their alleged invention or discovery; nor does the specification of the said patent describe the invention claimed in claims 1, 2, 3, 4, 5, 6, 7 and 8 in such full, clear and exact terms as to enable any one skilled in the art to practice such alleged invention without making experiments and discoveries of his own; but on the contrary, said specification, as the defendant avers, was deliberately, and for the purpose of deceiving the public, made to contain less than the whole truth relative to the alleged invention or discovery, or more than is necessary to produce the desired result, and

the claims of the patent for the same purpose were made to claim more than had been invented or discovered by the said patentees either jointly or severally.

(e) That the things alleged to be patented by said Patent No. 962,678 had been abandoned to the public.

10. The defendant further avers, on information and belief, that in view of the state of the art prior to the alleged invention of said Letters Patent No. 962,678 the claims thereof, regardless of their language, to be sustained as valid must be so construed as not to cover any process of ore concentration heretofore or now carried on by the defendant.

11. The defendant further avers, upon information and belief, that by reason of the acts done by the applicants in the prosecution before the United States Patent Office of the application which matured into Letters Patent No. 962,678 the plaintiff is now estopped from alleging that the claims of said patent, or any of them, can be construed to cover any process of ore concentration heretofore or now carried on by the defendant.

12. The defendant further answering denies the equity of the plaintiff's bill of complaint and avers that the plaintiff is not entitled to an injunction nor to an account of profits, nor to damages, nor to any royalty or recovery whatsoever against this defendant, nor to any relief whatsoever, as prayed for in the said bill of complaint.

All of which matters and things this defendant is ready to aver, maintain and prove as this Honorable Court shall direct, and the defendant prays that the bill of complaint be dismissed, and that the defendant shall recover its costs and disbursements in this suit.

MAGMA COPPER COMPANY,

By H. E. DODGE,

Secretary.

WOODMAN, WHITEHOUSE & LITTLEFIELD,

Solicitors for Defendant.

PENNIE, DAVIS, MARVIN & EDMONDS,

Of Counsel for Defendant.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

NOTICE.

PENNIE, DAVIS, MARVIN & EDMONDS, ESQS.,
165 Broadway, New York City.
ALBERT S. WOODMAN, Esq.,
Portland, Maine.

Please take notice that on Friday, March 30, 1923, at 10 o'clock in the forenoon, or as soon thereafter as counsel can be heard, we shall appear before his Honor Judge Hale and present the motion and annexed affidavits, a copy of which is handed you herewith.

HENRY D. WILLIAMS,
WM. HOUSTON KENYON,
LINDLEY M. GARRISON,
Of Counsel for Plaintiff.
SIDNEY ST. F. THAXTER,
Solicitor and of Counsel for Plaintiff.

Service of the above notice and receipt of copy of the motion and annexed affidavits is hereby acknowledged this 26th day of March, 1923.

WILLIAM H. DAVIS.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

MOTION.

Now comes the plaintiff Minerals Separation North American Corporation and moves for an order of this Court directing an inspection of defendant's mill at Superior, Arizona, by counsel and experts for plaintiff and the taking of specimens of material of defendant's process at various stages thereof, and that the depositions *de bene esse* of the general manager, general superintendent, mill superintendent, J. Garrett, former mill superintendent, and such other officers or employees of the defendant as have knowledge of the operations of the defendant during the three months preceding the commencement of this suit may be taken by the plaintiff at Superior, Arizona, under the provisions of Sections 863-867 Revised Statutes, the taking of such depositions to be begun on or about May 1, 1923, and for such other and further relief as to the Court may seem meet.

In connection with this motion plaintiff submits the annexed affidavits of Henry D. Williams, Alfred A. Cook, James Wilding and Wm. Houston Kenyon.

HENRY D. WILLIAMS,
WM. HOUSTON KENYON,
LINDLEY M. GARRISON,
Of Counsel for Plaintiff.

SIDNEY ST. F. THAXTER,
Solicitor and of Counsel for Plaintiff.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

AFFIDAVIT OF HENRY D. WILLIAMS FOR PLAINTIFF.

STATE OF NEW YORK,
COUNTY OF NEW YORK. } *ss.:*

HENRY D. WILLIAMS being duly sworn says:

I am of counsel for the plaintiff, and have had charge of all proceedings in this suit and in all the litigation in this country involving the same general subject.

This suit was commenced in January, 1920, by the filing of the bill of complaint on January 9 and the service of the *subpoena ad respondendum* on January 10. Defendant's time to file its answer or take other action with respect to the bill of complaint was extended by stipulation from time to time, and on or about April 22, 1920, defendant served notice of motion for a bill of particulars, and thereafter the time for filing defendant's answer was extended pending the disposition of said motion. The motion was heard before his Honor Judge Hale on July 30, 1920, and was denied. Thereafter there were other extensions by stipulation and defendant's answer was filed October 1, 1920.

Thereafter, on November 2, 1920, defendant obtained an order for the taking of a deposition *de bene esse* of Leslie Bradford at Salt Lake City, Utah, and such deposition was duly taken and filed.

More than a year thereafter, on December 30, 1921, defendant obtained an order for the taking of the deposition *de bene esse* of Theodore J. Hoover at New York City, but a few days later defendant's counsel notified plaintiff's counsel that this deposition would not be taken, and it was not taken.

The suit as originally commenced included Minerals Separation, Limited, a British corporation, as one of the plaintiffs, and was for infringement of Letters Patent No. 835,120 of November 6, 1906, as well as for the patent now in suit. It was one of six suits against five defendants brought in this district by these two plaintiffs for infringement of these two patents. In May, 1922, four of these suits, the one against Chino Copper Company, the one against Ray Consolidated Copper Company and the two against the Nevada Consolidated Copper Company were settled by agreement and discontinued. At the same time the longer pending suits then in accounting proceedings, against Butte & Superior Mining Company and Miami Copper Company, were settled and discontinued.

In June, 1922, Minerals Separation, Limited, assigned all its right, title and interest in and right of action, claim and demand under these patents to the plaintiff Minerals Separation North American Corporation, and plaintiff, being reliably advised that the operations of the defendant at the time of the commencement of the suit and through substantially the entire period of infringement and so long as they were continued after the commencement of the suit, involved the use of a soluble mineral-frothing agent such as is described and claimed in Patent No. 962,678, now alone in suit, and did not include the use of an oily mineral-frothing agent such as is described and claimed in Patent No. 835,120, a stipulation was entered into that the bill of complaint herein be dismissed with respect to Patent No. 835,120 without prejudice, and that a supplemental and amended bill of complaint by Minerals Separation North American Corporation as sole plaintiff, charging infringement only of Patent No. 962,678 should be filed. This stipulation and

supplemental and amended bill of complaint were filed September 28, 1922, and defendant's answer to the supplemental and amended bill of complaint was filed September 29, 1922.

Late in June, 1922, I was advised that a settlement of the present suit was in contemplation. On August 1, 1922, I sailed for Europe on my vacation and returned in the latter part of September, 1922. Shortly after my return I was advised that negotiations for settlement of this suit were proceeding, and finally, early in November, 1922, I received definite instructions from Alfred A. Cook, Esq., vice-president and general counsel of the plaintiff, to suspend all work on the case.

In the latter part of February, 1923, I was advised that the negotiations for settlement had suddenly terminated and that preparations for the trial were to be resumed and I thereupon advised associate counsel and resumed preparations.

My associate counsel in this suit and in all of the other suits above referred to involving this subject-matter are Wm. Houston Kenyon and Lindley M. Garrison, Esqs., and we had agreed in conference some time prior to last summer that it was necessary to the proper presentation of this case that mill-size operations should be conducted in glass-sided pneumatic cells in the presence of the Court, so as to avoid the misunderstandings which would naturally arise and which actually did arise on the appeal in the Miami suit as to such operations from demonstrations in miniature apparatus such as could be used in a court room. We therefore advised the construction of such a mill and recommended that it be located at Boston so as to be within easy reach of the Judges of the Court of Appeals, having previously obtained from Judge Peters an intimation that it would be agreeable to him to go to Boston to see the demonstration during the trial. I may add that this mill is a heavy affair which has to be erected on properly prepared foundations and cannot be moved about without dismantlement and re-erection.

It is my opinion that the demonstrations which we expect to carry on before the Court and defendant's representatives in this Boston demonstration mill will be necessary for the proper presentation of the facts in issue at the trial.

On February 27, 1923, I received a letter from defendant's counsel suggesting that we arrange for the setting of the case for trial some time between the first and tenth of May. I replied by a letter dated and delivered March 1, 1923, a copy of which is attached hereto. I had been advised, probably erroneously, that defendant's mine had resumed operations. I was also advised that operations of defendant's mine and mill had been shut down more than two years ago, and so far as I am advised defendant has committed no acts of infringement for more than two years, although it expects to resume its infringing acts on April 15th next.

On the same day, March 1, 1923, I received a letter in reply from defendant's counsel, a copy of which is hereto annexed.

I advised Mr. Kenyon as to this correspondence, and he advised me that there was then some uncertainty as to his trial engagements, and in the meantime I prepared a statement of information desired as to defendant's operations immediately prior to the commencement of the suit such as we deem necessary in order that our demonstration mill at Boston should faithfully reproduce these operations.

On March 14, 1923, I sent to defendant's counsel a letter of that date, a copy of which is hereto annexed, and with it the document entitled "Operations of Mill of Magma Copper Company during October, November and December, 1919." I have received no letter in reply, but have been advised by Messrs. Davis and Sage, of counsel for defendant, that the ore in the bins at the defendant's mill is not run-of-mine ore but what has been gathered during exploration operations during the shut-down, and that serious objection would be made to using it in any demonstrations as representative of defendant's ore; also that the mill expects to resume operations about the middle of April and that run-of-mine ore can-

not be supplied until after these operations are resumed; also that defendant's counsel deem an inspection of their mill unnecessary (and, of course, it must be of the mill in operation) and will not consent to delaying the trial for such inspection; also defendant's counsel decline to go to the trouble of supplying the information called for in the statement annexed to my letter of March 14, 1923, and will only go to the extent of correcting any errors in a stipulation which we may send to them as to defendant's operations. I thereupon said to them that we would have to take the depositions of such officers and employees of the defendant as have knowledge of the operations of the defendant during the three months preceding the commencement of this suit, and that we would apply to the Court for an order of inspection and an order for taking these depositions at Superior, Arizona, at that time.

I deem it necessary in preparation for the trial, and particularly for the demonstrations that we expect to make at the Boston mill, that this information be obtained. I reasonably expected to obtain it by stipulation, since it is the kind of data that every mill keeps records of for the purpose of keeping informed as to its operations, and I was quite surprised when it was refused, as there was a general understanding between Mr. Davis and myself that a stipulation would be entered into.

Subscribed and sworn to before
me this 26th day of March, 1923.

HENRY D. WILLIAMS.

(Seal) F. L. REQUA,

Notary Public, New York County No. 298.

March 1, 1923.

PENNIE, DAVIS, MARVIN & EDMONDS, ESQS.,
165 Broadway, New York City.

Attention of Mr. Merton W. Sage.

Dear Sirs:

We are in receipt of your letter of the 26th ultimo with enclosures as noted, for which we thank you.

We have been instructed to co-operate with you in obtaining as early a date as possible for the trial of the suit of Minerals Separation North American Corporation v. Magma Copper Company. We will be much pleased to do so, but hardly think that matters are now sufficiently advanced for us to agree upon your suggested dates of from the first to the tenth of May. Indeed one of our associate counsel, Mr. William H. Kenyon, who will take part in the trial, has a definite trial engagement for a long trial commencing May 14th and probably consuming the balance of the month of May.

In our preparations for the trial we will need to use a considerable amount of defendant's ore. We understand that the mine is now in operation and there should therefore be no difficulty in supplying us with "run-of-mine ore." We wish to have it dry crushed to the condition in which it would be supplied to the special grinding machinery of a flotation section, say not exceeding three-fourths inch cubes. To facilitate forwarding we would like a minimum carload, probably in the neighborhood of thirty tons, packed in bags marked "Keep Dry," to be shipped as freight and addressed

"Minerals Separation North American Corporation,
Roxbury, Mass.
Ruggles Street Yard."

We also wish a specimen of the flotation agent used by the defendant, which we understand is X-cake. We would like twenty-five pounds in a sealed container; also, if the operations involve the addition of lime, as we understand they do,

one hundred pounds of the lime used, in a sealed container; also ten gallons of the fresh water used in the flotation plant in a sealed container, these smaller samples to be shipped by express addressed

"Frank A. Root,
65 Whitney Street,
Boston, 20,
Mass."

When we last appeared before Judge Hale in this case the Judge made it perfectly clear that he did not favor obtaining information as to acts charged to be infringing by interrogatories, and that he expected counsel to draw up a proper stipulation. As we have said to your Mr. Davis, we are quite willing to meet the Judge's views in this respect but before doing so we wish an opportunity for counsel and experts to visit and examine the defendant's mill and take such specimens as they desire, with duplication of the same of course, to the defendant's representatives. We would like to arrange for this inspection at the earliest possible date.

Will you kindly give these matters consideration and advise us at your early convenience.

Very truly yours,

(Sgd.) WILLIAMS & PRITCHARD.

HDW

(COPY)

PENNIE, DAVIS, MARVIN AND EDMONDS.
165 Broadway, New York.

March 1st, 1923.

Messrs. Williams & Pritchard,
61 Broadway,
New York City.

Gentlemen:

Replying to your letter of March 1st, 1923, respecting the trial of the suit of Minerals Separation v. Magma Copper Company, we beg to advise you that we are prepared to advance the date of the trial to the latter part of April in order to accommodate Mr. Kenyon's engagement commencing May 14th. Unless we can agree upon a date for the commencement of the trial, prior to May 15th, we will feel compelled to submit the matter to the Court with the view of obtaining the earliest date possible for the commencement of the trial.

Your understanding that the mine of the Magma Copper Company is now in operation is erroneous. No mining operations are now being carried on at the Magma mine, nor have such operations been carried on since early in 1921. The property of the Magma Copper Company at Superior, Arizona, has been and is still undergoing considerable development preparatory to the resumption of mining operations in the future.

Under the circumstances, it appears impossible for us to supply you with any "run-of-mine ore." Neither are we in a position to furnish you samples of X-cake, lime or fresh water used in the flotation plant, since the plant is not now in operation and has not been in operation since early in 1921.

Since the flotation plant of the defendant is not now in operation, no useful purpose could possibly result from a visit to the Magma mill by plaintiff's counsel and experts.

Very truly yours,

(Sgd.) MERTON W. SAGE.

March 14th, 1923.

PENNIE, DAVIS, MARVIN AND EDMONDS, ESQS.,
165 Broadway,
New York City, New York.

Attention Mr. Merton W. Sage.

Dear Sirs:

I have awaited the final fixing of Mr. Kenyon's engagements before replying to your letter of the first instant. On April second he will enter upon a long trial at Wilmington, Delaware, which will probably take three or four weeks, and he is now and expects to be, up to the commencement of this trial, actively engaged in preparations for it. Upon the completion of this trial there will not only be the usual briefing and argument, but also preparations for another trial at the same place which Judge Morris has set for May 28th, and which will probably take two weeks. Mr. Kenyon therefore cannot take up the Magma trial earlier than the middle of June.

Aside from Mr. Kenyon's present inescapable obligations in other work, it will not be possible for plaintiff's case to be adequately presented at a trial commencing earlier than June 15th. For the proper presentation thereof it will be necessary to exhibit to the court a fair representation of defendant's operations as carried on at the time of the commencement of the suit, not in miniature apparatus, as was done at the Miami trial, but in apparatus of sufficient size to adequately exhibit the operations. We have, therefore, at considerable expense, constructed in Boston a small demonstration mill with glass-sided Callow cells, and in this demonstration mill we propose to exhibit to the court operations with defendant's ore and defendant's flotation agents fairly representing defendant's operations.

For the operation of this demonstration mill we need a considerable quantity of defendant's ore and we have therefore offered to purchase from the defendant a carload of

this ore and to pay the expenses of transporting it from defendant's mines to our demonstration mill. We are quite sure that a reasonable effort to meet us in this regard would result in the shipment of the ore by the defendant during the present month. Our information is that defendant's enlargement of its plant is practically completed and that its operations are to be started during the present month.

As to defendant's flotation agents, you have not met our request by any statement that it is impossible to supply us with the specimens required of such material as was used at the time of the commencement of the suit. We wish of course to approximate as closely as possible conditions at that time and should expect you to reasonably co-operate with us to that end.

The two other matters which we insist upon as necessary to the trial are an inspection of defendant's mill by our representatives and a precise statement, either by stipulation or deposition, of defendant's operations at the time of the commencement of the suit. The inspection can be arranged to take place promptly after defendant's mill starts up. We take it that you are inclined to meet us as to the stipulation and we therefore send you herewith a memorandum of information desired which we have no doubt can be supplied from the information and records at defendant's mill.

Very truly yours,

(Sgd.) HENRY D. WILLIAMS.

1 enc.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,

v.

MAGMA COPPER CO.

Operations of Mill of Magma Copper Company during October, November and December, 1919.

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1. Physical character of the ore milled.

2. Mineralogical composition of the ore milled.

3. Average analysis of the ore milled, giving the percentage of—

Copper—present as sulphide mineral or minerals, as oxidized mineral or minerals and as metal, if any.
Iron,
Zinc,
Lead,
Lime, (Magnesia, Baryta, etc.)
Alumina,
Silica,
Sulphur.

4. The average amount of silver and gold present in the ore, stated in ounces per ton of ore.

5. Description of apparatus and machinery used in the mill, with drawings of apparatus and machinery of flotation plant.

6. Milling flowsheet in detail, showing not only the course of the ore or ore pulp, but also the following:

(a) The point or points at which fresh water is added to the ore or ore pulp;

(b) The point or points at which return water is added to the ore or ore pulp;

(c) The tons of ore and tons of water fed to each class or group of concentrating machines or principal apparatus per unit of time (minute, hour, day);

(d) The tons of concentrate and accompanying water discharged from each class or group of concentrating machines or principal apparatus per unit of time;

(e) The tons of middlings and accompanying water discharged from each class or group of concentrating machines or principal apparatus per unit of time;

(f) The tons of tailings and accompanying water discharged from each class or group of concentrating machines or principal apparatus per unit of time;

(g) The copper assay of the solid products discharged from each group of concentrating machines or apparatus;

(h) The point or points at which flotation agents are added to the ore or ore pulp, naming each agent.

7. If changes were made in flowsheet used during October, November and December, 1919, and in January, 1920, prior to January 10, 1920, give each flowsheet.

8. The total tonnage of ore milled during such three months of operations.

9. The tonnage of ore milled in each such month and the average percentage therein of copper in the sulphide and oxide form, iron and insoluble or silica. Also the silver and gold content thereof.

10. The tonnage of concentrates produced in each such month by the concentrating tables, and the average percentage therein of copper in sulphide and oxide form, iron and insoluble. Also the silver and gold content thereof.

11. The tonnage of feed to the flotation plant in each such month and the average percentage therein of copper in sulphide and oxide form, iron and insoluble. Also the silver and gold content thereof.

12. The tonnage of flotation concentrates produced in each such month and the average percentage therein of copper in sulphide and oxide form, iron and insoluble. Also the silver and gold content thereof.

13. The tonnage of flotation tailings produced in each such month and the average percentage therein of copper in sulphide and oxide form. Also the silver and gold content thereof.

14. The tonnage of general mill tailings produced in each such month and the average percentage therein of copper in sulphide and oxide form. Also the silver and gold content thereof.

15. The nature and weight of all flotation agents used in each such month, including such as are of an acid or alkaline nature.

16. The number, make and rated capacity of the blowers used in the flotation plant; also speed of operation and pressure against which they were operated and displacement per revolution of each blower.

17. Specimen records and reports of daily operations, including tonnages treated, assays of mill heads, general concentrates and general tailings, flotation heads, concentrates and tailings, tonnages of flotation heads, amount of each flotation agent used.

18. The specification under which each agent was purchased, and the chemical analysis of the agent purchased.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

AFFIDAVIT OF ALFRED A. COOK FOR PLAINTIFF.

STATE OF NEW YORK,
COUNTY OF NEW YORK, } *ss.:*

ALFRED A. COOK being duly sworn deposes and says:

I am vice-president and general counsel of Minerals Separation North American Corporation, the complainant in the above-entitled suit.

During the late spring of 1922 I adjusted the differences existing between the Minerals Corporation and Utah Copper Company, Miami Copper Company, Ray Consolidated Copper Company, Chino Consolidated Copper Company, Nevada Consolidated Copper Company and Butte & Superior Mining Company and all litigation between the Minerals Corporation and them was discontinued.

I was asked in behalf of the Magma Copper Company after the aforesaid adjustment had been concluded whether I would be willing to adjust similarly the differences between the Magma Copper Company and the Minerals Corporation, and I said that I would. I left for Europe for my vacation on June 24, 1922, and was advised shortly before I left that the Magma Copper Company was giving attention to the situation, but had not definitely concluded whether it would adjust or not. I gave the above information to Mr. Henry D. Wil-

liams, patent counsel of the Minerals Corporation, and stated that I doubted very much whether the suit would be tried in the fall.

During the latter part of September, 1922, a few days after I returned from Europe, I was invited by Mr. William B. Thompson, the controlling owner of the Magma Copper Company, to confer with him, and I did so. He stated at our conference that he was shortly leaving for Europe, but would speak with his associate, Mr. Charles F. Ayer, the president of the Magma Copper Company, concerning his views and he asked me to put myself in touch with Mr. Ayer, and I wrote to Mr. Ayer on September 28, 1922. I met Mr. Ayer during the middle of October, 1922, and further conferences were had with him and the counsel for the Magma Copper Company later in the month and during November, 1922. My conferences with Mr. Ayer continued through December, 1922, and through January and partly through February, 1923. He and I sought to determine whether some amicable adjustment could not be reached as to the matters in difference between the Minerals Corporation and the Magma Copper Company. As our negotiations proceeded and as a result of what Mr. Ayer said to me I felt called upon in November, 1922, to advise, and did advise Mr. Henry D. Williams, patent counsel for the Corporation, to stop all work in connection with the preparation for trial of the above-entitled suit.

On February 17, 1923, following a conference with Mr. Ayer at which I thought we had reached a basis of understanding, I received a letter from Mr. Ayer reading as follows:

"New York, February 17, 1923.

"Alfred A. Cook,
111 Broadway,
New York, N. Y.

Dear Mr. Cook:

I have requested Messrs. Pennie, Davis, Marvin and Edmonds, attorneys for the Magma Copper Company, to have the suit brought against it by the Minerals Separation Company set down for trial and tried at the ear-

liest possible date. There does not appear to be any other way of disposing of the litigation except to try the case.

Yours very truly,

CHARLES F. AYER."

I acknowledged its receipt as follows:

"February 21, 1923.

"Charles F. Ayer,
14 Wall Street, City.

Dear Mr. Ayer:

I have your letter of February 17 and note that you have requested Messrs. Pennie, Davis, Marvin & Edmonds to have the suit brought against the Magma Copper Company by Minerals Separation set down for trial and disposed of at the earliest possible date. I have informed Dr. Gregory of the conclusion which you have reached and he will in turn advise Messrs. Williams & Pritchard, the patent counsel for Minerals Separation.

Sincerely yours,

ALFRED A. COOK."

I appreciate that the conferences which I have had with Mr. Ayer were privileged and I have avoided on that account making any reference to what was said. It has seemed to me, however, proper to call the attention of the Court to the fact that as a result of negotiations initiated by the defendant, and which extended from September 28, 1922, to February 17, 1923—a period of approximately five months—patent counsel for complainant was instructed by me to suspend his efforts to prepare for trial, and that it has been by reason of the instructions so given that patent counsel has not advanced with his preparation to the point where it otherwise would have been.

ALFRED A. COOK.

Subscribed and sworn to before
me this 26th day of March, 1923.
(Seal) JOHN F. JACOBS,
Notary Public, Kings County, No. 38.

Certificate filed in New York County No. 101.

Kings County Reg. No. 3013. New York County Reg. No. 2026.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,

Defendant.

AFFIDAVIT OF JAMES WILDING FOR PLAINTIFF.

STATE OF NEW YORK,
COUNTY OF NEW YORK, } *ss.:*

JAMES WILDING being duly sworn says:

I am a metallurgist in the employ of the plaintiff and have had charge of the erection in Boston by the plaintiff of an ore concentrating mill with glass-sided pneumatic cells for the purpose of illustrating to the Court the operations carried out in the defendant's mill at Superior, Arizona. The erection of this mill was commenced in July, 1922, and the cost of the mill has been in the neighborhood of $10,000. It includes heavy grinding machinery, classifying apparatus and pneumatic cells, erected on proper foundations, with means for handling the material treated and disposing of the products. It was finished in November of 1922. I was generally advised before that time that the parties were engaged in negotiations for the settlement of the suit. In the latter part of February, 1923, I was instructed by counsel to proceed with preparations for the trial, and shortly thereafter I went to Boston and tested and operated the mill with Miami ore, the only ore then available.

Upon being supplied with the necessary information as to the operations of the defendant and with a sufficient

amount of defendant's ore, I expect to be able in this mill to carry on operations faithfully reproducing on a smaller scale, but nevertheless on a mill scale, the operations of the defendant at Superior, Arizona.

I was requested by plaintiff's counsel, Mr. Williams, to give him a statement of the information necessary in order to assure faithful reproduction of defendant's operations, and with Mr. Williams I prepared the series of statements in the document entitled "Operations of Mill of Magma Copper Company during October, November and December, 1919," which is annexed to the accompanying affidavit of Mr. Williams.

For the complete interpretation of the data in connection with the operations at defendant's mill, and in order to assure a reproduction of those operations, it is, in my opinion, necessary that the defendant's mill in operation should be inspected by plaintiff's counsel and experts, and the mere fact that the mill has been enlarged or even materially altered since the commencement of this suit, provided pneumatic cells are still used, would not militate against the usefulness of such an inspection and the necessity of such an inspection in order that I may show to the Court a reproduction of defendant's operations and describe to the Court the manner in which these operations are carried on.

Subscribed and sworn to before
me this 24th day of March, 1923.

JAMES WILDING.

(Seal) F. L. REQUA,

Notary Public, N. Y. County, No. 298.

IN THE UNITED STATES DISTRICT COURT FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

AFFIDAVIT FOR PLAINTIFF OF WM. HOUSTON KENYON.

STATE OF NEW YORK,
COUNTY OF NEW YORK, } *ss.*:

WM. HOUSTON KENYON being duly sworn deposes and says:

I am of counsel for plaintiff in this case.

I am also of counsel for plaintiff in Victor Talking Machine Company vs. The Brunswick-Balke-Collender Company and John Bailey Browning, now pending in the United States District Court for the District of Delaware and set for trial there on April 2d, 1923. That case was so set for trial last November. It involves several counsel and a large number of witnesses on both sides and several issues, including an action between interfering patents and an infringement counterclaim, and it is anticipated that the trial will occupy at least three weeks in open court and probably more, and if more that it will probably have to be continued, owing to engagements of the Court from April 23d to about May 7th, and that in any event I will be engaged in May with the preparation of brief and for oral argument and with the oral argu-

ment itself in that case, which I anticipate will be continued to some time in the middle or latter part of May. I have also an oral argument set for about the first of May in a case pending in the Southern District of New York entitled Charles S. Bird v. Sears-Roebuck & Company, which was tried February 27th to March 1st, inclusive, and set for argument early in May. I have also a trial, Victor v. The Brunswick-Balke-Collender Company, pending in the District of Delaware, which is at present fixed for the week of June 4th and which if tried at that time will require my uninterrupted attention for at least two weeks preceding in preparation therefor, and the trial of which will occupy a week.

Under these circumstances it would be exceedingly inconvenient and so far as I can now see practically impossible for me to take part in the trial of this case at any time prior to about the middle of June and to make the preparation for same that I desire, and would have, to make.

I confirm the statements in the affidavit of Henry D. Williams as to the agreement at conference of present counsel in this case, Judge Garrison, Mr. Williams and myself, that it was necessary to the proper presentation of this case that mill-size operations should be conducted in glass-sided pneumatic cells in the presence of the Court. Mr. Williams and I conducted the trial in behalf of the plaintiff in the Miami case, preceding the trial by an inspection of defendant's mill at Miami, Arizona. At the trial we were limited to such demonstrations of the operation of the process as could be carried on in the court room, and defendant presented demonstrations in miniature apparatus which gave an altogether wrong impression of the degree and character of the agitation in pneumatic cells, and we had only small court room apparatus, which were insufficient to correct this wrong impression. The final result on the appeal was that the Court accepted these demonstrations in miniature apparatus as representative of what took place in the defendant's operations at the mill. It is, in my opinion, of great importance that we should be able adequately to show to this Court by such demonstrations as we expect to be able to give at the mill constructed

by the plaintiff in Boston the real nature of the operations o defendant's pneumatic cells.

Subscribed and sworn to before me this 26th day of March, 1923.

WM. HOUSTON KENYON.

(Seal) EDWIN SEGER,
Notary Public for Queens County,
Certificate filed in New York County.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

On motion of the plaintiff and on reading and filing o affidavits of Henry D. Williams, verified March 26, 192 Alfred A. Cook, verified March 26, 1923, James Wilding verified March 24, 1923, and Wm. Houston Kenyon, verifie March 26, 1923, and on hearing Henry D. Williams, Lindle M. Garrison and Sidney St. F. Thaxter in support of sai motion, and William H. Davis, Esq., in opposition thereto and, after due consideration, it is hereby

ORDERED, That the plaintiff be permitted to inspect th defendant's mill in active operation at Superior, Arizona represented by counsel and experts, and take specimens o material of defendant's processes at various stages thereof and it is further

ORDERED, That the plaintiff may take depositions *de bene esse* of such officers or employees of the defendant as have knowledge of the operations of the defendant during the three months preceding the commencement of this suit; such depositions to be taken at Superior, Arizona, at the time of the inspection aforesaid under the provisions of Sections 863-867 Revised Statutes, such inspection to take place at a time mutually to be agreed upon between counsel and in default of such agreement and inspection prior to May 7, 1923, apply to this court for further directions in the premises. The counsel for the plaintiff hold themselves in readiness to make the said inspection between the fifteenth of April and the seventh of May, 1923.

Approved as to form:

JOHN A. PETERS,
United States District Judge.

HENRY D. WILLIAMS,
LINDLEY M. GARRISON,
For Plaintiff.

WILLIAM H. DAVIS,
For Defendant.

(Sgd. Mar. 30, 1923.)

IN THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

ORDER UPON INTERROGATORIES.

Upon the application of Messrs. Woodman, Whitehouse & Littlefield, solicitors for defendant, made pursuant to Equity Rule 58 it is

ORDERED, That the defendant have leave to file the interrogatories hereto annexed and that the same be answered by such officer or agent of the plaintiff, Minerals Separation North American Corporation, as has knowledge of the facts inquired of.

This order is without prejudice to the right of said plaintiff under Equity Rule 58 to present objections to said interrogatories or any of them in the manner prescribed by said rule, within ten days after service of said interrogatories, and to defer answers until the objections are determined.

CLARENCE HALE,
District Judge.

May 21, 1923.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

DEFENDANT'S INTERROGATORIES AND PLAINTIFF'S ANSWERS AND OBJECTIONS THERETO.

And now comes the defendant in the above entitled cause and files the following interrogatories under the provisions of Equity Rule No. 58 for the discovery by the plaintiff of facts and documents material to its defense of the cause, to be answered under oath by the president or other duly qualified officer of the plaintiff.

Interrogatory No. 1.

In what capacity, if any, were Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard, Arthur Edward Cattermole, John Ballot, Arthur Howard Higgins, Henry Howard Greenway, George Albert Chapman, and William Sidney Stevens employed or retained by (1) Minerals Separation, Limited, or its predecessor or predecessors, and by (2) the plaintiff Minerals Separation North American Corporation

(a) During the year 1902?
(b) During the year 1903?
(c) During the year 1904?
(d) During the year 1905?
(e) During the year 1906?

(f) During the year 1907?
(g) During the year 1908?
(h) During the year 1909?
(i) During the year 1910?
(j) From January 1, 1911, to December 31, 1920?
(k) With respect to each of said persons, has such employment or retainer been continuous since the beginning thereof, and if not, state with respect to whom, and during what period or periods, the employment was discontinued?

Answer to Interrogatory No. 1.

The plaintiff having been incorporated on the seventh day of December, 1916, and not having in its possession or under its custody or control any document furnishing the information, is without knowledge as to the capacity in which the persons named were employed or retained by Minerals Separation, Limited, or its predecessor or predecessors during any of the years enumerated or designated by the letters (a) to (j) inclusive, excepting to the extent that such persons have testified concerning their said employment or retainers in suits in which plaintiff was a party. Said suits and the parties inquired about testifying therein concerning their employments or retainers are:

Minerals Separation, Limited, Minerals Separation American Syndicate, Limited, and Minerals Separation North American Corporation v. Butte & Superior Mining Company (the record therein includes the evidence in full in the prior suit of Minerals Separation, Limited, and Minerals Separation American Syndicate, Limited, v. Hyde), in the United States District Court for the District of Montana. John Ballot, Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard, Arthur Howard Higgins, George Albert Chapman.

Minerals Separation, Limited, v. Miami Copper Company, in which by supplemental bill the plaintiff became a party plaintiff, in the United States District Court for the District of Delaware. John Ballot, Arthur

Howard Higgins, George Albert Chapman (See also the testimony of these witnesses and Messrs. Sulman and Picard stipulated therein in abbreviated form from the aforesaid suit against Hyde).

Wolf Mineral Process Corporation v. Minerals Separation North American Corporation, in the United States District Court for the District of Maryland. Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard and Arthur Edward Cattermole.

With respect to the capacity in which the various persons named were employed or retained by the plaintiff since its incorporation on December 7, 1916, the facts are as follows:

Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard, Arthur Edward Cattermole, Henry Howard Greenway and William Sydney Stevens were never employed or retained by the plaintiff, except that said Sulman, Picard and Cattermole were requested by plaintiff in June, 1922, to take the time necessary to prepare to testify with respect to the facts upon which they were to be interrogated in the suit of Wolf Mineral Process Corporation against Minerals Separation North American Corporation and were called as witnesses therein and their depositions taken at London under commission in August and September, 1922, and were compensated for the time and labor involved in such work.

With respect to John Ballot, he was president of the plaintiff corporation from the time of its incorporation until his death on April 1, 1922.

With respect to Arthur Howard Higgins, he was employed as chief metallurgist from the inception of the plaintiff on December 7, 1916, and remained such continuously to the end of the period inquired of.

With respect to George Albert Chapman, he was employed by the plaintiff from the time of its incorporation down to March, 1918, as a metallurgist, and from the latter date continuously to the end of the period inquired of as assistant chief engineer.

Interrogatory No. 2.

Is said Henry Livingstone Sulman the same H. Livingstone Sulman who presented at a meeting of the Institution of Mining and Metallurgy, held in London on or about November 20, 1919, a paper entitled "A Contribution to the Study of Flotation," which paper was published in the Bulletin of The Institution of Mining and Metallurgy for November, 1919?

Answer to Interrogatory No. 2.

Yes.

Interrogatory No. 3.

In what capacity, if any, was Theodore J. Hoover employed by Minerals Separation, Limited, in 1907?

(a) When did that employment begin?

(b) When did that employment terminate?

Answer to Interrogatory No. 3.

In the deposition of Theodore J. Hoover, which has been stipulated into this case at defendant's request, said Hoover testified that in September, 1906, he became general manager of Minerals Separation, Limited, and that his employment was from 1906 to 1910 as general manager and consulting engineer, and for the purposes of the instant case these statements will not be disputed. It also appears in the testimony of Mr. John Ballot in the suit against Hyde above referred to that said employment of Mr. Hoover terminated on the 31st of December, 1910, and that said Hoover was not thereafter employed by Minerals Separation, Limited.

Interrogatory No. 4.

(a) Did said Sulman and said Picard, or either of them, prior to January, 1908, prepare a document or treatise entitled "The Theory of Concentration Processes Involving Surface Tension"?

(b) Did said Sulman and said Picard, or either of them, prior to January, 1908, prepare a document or treatise relating to the theory of concentration processes involving surface tension, whatever or however entitled?

(c) If said documents or treatises, or any of them, referred to under sub-divisions (a) and (b) hereof were so prepared, did said Sulman and said Picard, or either of them, deliver an original, or originals, or a copy or copies thereof, to Minerals Separation, Limited, or any of its officers, and if so, state what documents or treatises were so delivered and to whom.

(d) Produce each and every of the documents and treatises referred to under sub-divisions (a) and (b) hereof.

(e) Produce each and every of the notes and memoranda of research and experiments on surface tension phenomena in relation to flotation concentration of ores made or written by, or under the direction of, said Sulman and said Picard, or either of them.

Answer to Interrogatory No. 4.

With respect to (a), (b), (c) and (d), Theodore J. Hoover, in a deposition given in a case in which plaintiff was one of the parties, gave testimony with respect to this subject-matter and produced a document entitled as in the interrogatory set forth, concerning which he testified, which document so produced by him is an exhibit annexed to said deposition, which latter has been at defendant's request stipulated into this case.

With respect to (e) thereof, plaintiff objects on the ground that the inquiry is too indefinite, too sweeping, and casts an undue burden upon the plaintiff to ascertain and produce all that the two persons named may have written upon the subject-matter inquired of.

Interrogatory No. 5.

Did said Sulman and said Picard, or either of them, or any officer or agent of Minerals Separation, Limited, at any time during the term of said Hoover's employment by

Minerals Separation, Limited, deliver to said Hoover a copy or copies of the documents or treatises referred to under Interrogatory No. 4?

(a) If yes, when and by whom was it so delivered?

Answer to Interrogatory No. 5.

Answered so far as plaintiff is able to do so by answer to Interrogatory No. 4.

Interrogatory No. 6.

Did said Sulman and said Picard, or either of them, on or about July 23, 1903, file an application for letters patent in Great Britain, which application was designated No. 16,285 of 1903, and which application was subsequently abandoned?

(a) If so, produce a true, correct and complete copy of the specifications and claims, if any, and the drawings, if any, of such abandoned application, and each and every of the letters and correspondence to and from the British Patent Office in connection therewith.

(b) If said application was filed, was it filed with the knowledge and consent of Minerals Separation, Limited, its predecessor or predecessors?

(c) If said application was filed, produce each and every of the correspondence and reports from said Sulman and said Picard, or either of them, or their associates, relating to experiments with, and the practice of, the several processes, and each of them, described therein?

(d) Produce the letter of July 27th, 1903, from G. Vautin (signed C. V.) to Sulman and Picard (addressed Dear S. & P.) *re* Gas Lifting Process; the letter of H. K. Picard to C. Vautin of August 7th, 1903, referring to Froment's anticipation of Gas Lifting Process; and the letter of August 4th, 1903, from C. Vautin, referred to in the first line of the said letter of August 7th, 1903, from said Picard to said Vautin.

Answer to Interrogatory No. 6.

Plaintiff having been incorporated on December 7th, 1916, and not having any document giving the information inquired of other than the document produced in

connection with this answer, has no knowledge relative to this subject-matter other than appears in such document and in the testimony of William H. Ballantyne in the suit against Hyde above referred to and the testimony of Sulman, Picard and Ballantyne in the suit of Wolf Mineral Process Corporation above referred to. It has in its possession and annexes hereto a certified copy of the abandoned British application No. 16,285, filed July 23, 1903, of said Sulman and Picard.

Interrogatory No. 7.

Did Minerals Separation, Limited, ever acquire any right, title and interest in, to or under British Patent No. 12,778 of 1902 to Alcide Froment?

(a) If so, what was the extent of such right, title and interest and when was it acquired?

(b) Did Minerals Separation, Limited, bring suit for infringement of said British Patent No. 12,778 of 1902 against the Ore Concentration Company (1905), Limited, in the High Court of Justice in England, and if so

(1) State when that suit was brought and when and how it was terminated.

(2) Describe the process which was alleged in said suit to be an infringement.

(3) Produce a copy of the *writ* and *statement of claim* and the *particulars of breaches* filed or delivered by the plaintiff in such case.

(c) Did Minerals Separation, Limited, its predecessor or predecessors, bring any other suit or suits for infringement of said British Patent No. 12,778 of 1902, and if so, state when such suit or suits were brought, the defendant or defendants in such suits, describe the processes alleged to infringe in each such suit, and state when and how such suits were terminated.

(d) Did Minerals Separation, Limited, its predecessor or predecessors, maintain the said British Patent No. 12,778 of 1902 in force for the full term for which the same was granted by payment of the annual renewal fees?

Answer to Interrogatory No. 7.

Plaintiff having been incorporated on December 7th, 1916, and not having any documents giving the information, has no knowledge in the respects inquired of excepting as appears in the testimony of John Ballot and William H. Ballantyne in the suit against Hyde above referred to, and the testimony of Henry L. Sulman and William H. Ballantyne in the suit of Wolf Mineral Process Corporation above referred to, and also excepting such information as may be derived from the published reports of opinions of the British Courts in the case referred to.

Interrogatory No. 8.

Did Minerals Separation, Limited, its predecessor or predecessors, or John Ballot, receive from Alcide Froment during the year 1903, or the year 1904, a certain written description, instructions and drawings relating to the concentration of minerals?

(a) If so, state when, and produce the original of such description, instructions and drawings.

Answer to Interrogatory No. 8.

Plaintiff having been incorporated on December 7th, 1916, and not having any documents giving the information, has no information in the respect inquired of excepting as appears in the testimony of H. F. K. Picard, John Ballot and W. H. Ballantyne in the suit against Hyde above referred to. The documents requested were in evidence therein, and in the suits against Butte & Superior Mining Company and Miami Copper Company, as Complainants' Exhibit Froment Description, together with a translation thereof, Complainants' Exhibit Froment Plan and Complainants' Exhibit Drawing A, and these documents are in the custody of plaintiff's counsel Henry D. Williams, Esq., and will be produced for inspection.

Interrogatory No. 9.

Produce each and every of the correspondence and documents passing between Minerals Separation, Limited, its predecessor or predecessors, or its or their agents, and Alcide Froment, his agent or agents, during the years 1903, 1904, and 1905.

Answer to Interrogatory No. 9.

Plaintiff having been incorporated on December 7th, 1916, and not having any of the correspondence or documents which it is requested to produce, can refer only to the evidence above referred to and to the assignment from Alcide Froment to John Ballot which was in evidence in the suits against Hyde, Butte & Superior Mining Company, and Miami Copper Company as Complainants' Exhibit Assignment Froment to Ballot, November 17th, 1903. This document is in the custody of plaintiff's counsel Henry D. Williams, Esq., and will be produced for inspection.

Interrogatory No. 10.

Produce each and every of the correspondence and reports from said Sulman and said Picard, or either of them, or their associates, relating to experiments with and the practice of the several processes, and each of them, described in letters patent of the United States, No. 793,808, granted to said Sulman and said Picard, and described in British patent No. 20,419 of 1903 and in the respective applications therefor.

Answer to Interrogatory No. 10.

Plaintiff cannot produce what is called for as it does not possess the same or have the same under its custody or control.

Interrogatory No. 11.

Produce the three letters from said Sulman and said Picard to John Ballot, Chairman, Minerals Separation,

Limited, dated respectively July 14th, 1903, July 27th, 1903, and August 11th, 1903, referred to in a certain letter from the same parties to the same addressee dated September 24th, 1903.

Answer to Interrogatory No. 11.

Plaintiff cannot produce what is called for as it does not possess the same or have the same under its custody or control.

Interrogatory No. 12.

Produce the original of each and every of the following reports and documents:

(a) *Sulman & Picard* to John Ballot, dated March 25, 1903,

(b) *Sulman & Picard* to John Ballot, dated May 5, 1903,

(c) *Sulman & Picard* to John Ballot, dated September 24, 1903,

(d) *Sulman & Picard* to John Ballot, dated November 19, 1903,

(e) *Sulman & Picard* to John Ballot, dated March 4, 1904,

(f) *Sulman & Picard* to John Ballot, dated April 19, 1904,

(g) *Sulman & Picard* to John Ballot, dated May 2, 1904,

(h) *Sulman & Picard* to Messrs. The Minerals Separation, Limited, dated May 18, 1904,

(i) *Sulman & Picard* to Messrs. Minerals Separation, Limited, dated February 17, 1905,

(j) *Sulman & Picard* to John Ballot, dated February 21, 1905.

(k) The report of Mr. Higgins, presumably bearing date of February 20, 1905, referred to in the Sulman & Picard Report, dated February 21, 1905.

(l) *Sulman & Picard* to John Ballot, dated March 3, 1905,

(m) The report of A. Howard Higgins, of March 2, 1905, together with curve diagrams, referred to in said Sulman & Picard Report, dated March 3, 1905.

(n) The report of A. Howard Higgins, of March 16, 1905, entitled "Further Report on Conditions of Granulation, March 16, 1905. Influence of the Percentage of Oil," and all correspondence between Minerals Separation, Limited, or its officers, and the said Higgins, or said Sulman and said Picard, or either of them, relating to said report,

(o) *Sulman & Picard* to John Ballot, dated May 3, 1905,

(p) *Sulman & Picard* to John Ballot, dated May 16, 1902.

(q) The report or paper addressed to "The Board of Directors, Minerals Separation, Limited," dated December 3, 1910, by Edward H. Nutter.

Note.—State what relations, if any, existed between said Nutter and Minerals Separation, Limited, during the year 1910, and what relations, if any, exist between the plaintiff and said Nutter at the present time.

(r) Each and every of the reports of George A. Chapman to C. F. Courtney and each and every of the reports of said Chapman or said Courtney to Minerals Separation, Limited, or to any of its officers during each of the years 1904 to 1908, inclusive, relating to the Cattermole process, or the process of United States Letters Patent No. 835,120, or to modifications of either of said processes, and all correspondence between said parties and Minerals Separation, Limited, or any of its officers, relating to said reports or said processes.

Note.—State what relations, if any, existed between said Chapman and said Courtney and Minerals Separation, Limited, or its officers, during each of the years from 1904 to 1909, inclusive.

(s) Each and every of the reports of said Chapman and said Higgins to Minerals Separation, Limited, or any of its officers during the years 1908 and 1909 relating to the processes of Letters Patent of the United States Nos. 835,120 and 962,678, or modifications of either of said processes, and all correspondence between said parties relating to said reports or said processes.

Answer to Interrogatory No. 12.

Plaintiff having been incorporated on December 7, 1916, and not having any documents giving the information, has no knowledge in the respect inquired of excepting as follows: the documents called for, or copies thereof, were in evidence in the suits against Hyde, Butte & Superior Mining Company and Miami Copper Company above referred to in respect to (a) to (j) inclusive, (l), (m) (excepting the curve diagrams), (n) (the report referred to and two letters of Minerals Separation, Limited, dated March 3 and March 6, 1905, but no other letters of the correspondence referred to, if any such existed), (o), (q) (with respect to the note, Edward H. Nutter in the suit against Hyde above referred to gave testimony with regard to the relations inquired of between himself and Minerals Separation, Limited. Said Nutter at the present time is chief engineer of the plaintiff), (r) (only the report of George A. Chapman to Theodore J. Hoover, Manager of Minerals Separation, Limited, dated August 16, 1907; with respect to the note, said Chapman and John Ballot in the suit against Hyde above referred to testified as to relations between said Chapman and C. F. Courtney and Minerals Separation, Limited, during a part of the period inquired of).

With respect to (s), this part of the interrogatory is objected to as an attempt on the part of the defendant to obtain from the plaintiff information in respect of evidence or testimony which plaintiff may use in support of plaintiff's case, and as not a legitimate use of interrogatories to obtain discovery to which defendant is entitled.

Interrogatory No. 13.

Produce the note book given Mr. John Ballot by said Arthur Edward Cattermole during 1902 or 1903, which note book contained an exposition of the Cattermole process, being a résumé of notes from Mr. Cattermole's note books.

Answer to Interrogatory No. 13.

In the suit above referred to of Wolf Mineral Process Corporation against plaintiff, Arthur Edward Cattermole testified that he had given to Mr. John Ballot a note book such as is called for and such note book is in evidence therein and is in the custody of Henry D. Williams, Esq., counsel for the plaintiff, and will be produced for inspection.

Interrogatory No. 14.

Produce the note book of said George Albert Chapman entitled or relating to "Australian Ore Concentration Syndicate-Results of Experimental Work" and "Work on the Scammel Oil Process Commenced February 9, 1903."

Answer to Interrogatory No. 14.

In the suit above referred to of Wolf Mineral Process Corporation against the plaintiff a laboratory note book of Messrs. Sulman & Picard, entitled as stated in the interrogatory, is in evidence and is in the custody of Henry D. Williams, Esq., counsel for the plaintiff, and will be produced for the inspection of defendant. Plaintiff has no knowledge of any other note book so entitled.

Interrogatory No. 15.

Is said Henry Livingstone Sulman the same Henry Livingstone Sulman named or described in Letters Patent of Great Britain No. 27,749 of 1913, and Letters Patent of Australia No. 12,416 of 1914, relating to the concentration of ores?

Answer to Interrogatory No. 15.

Since plaintiff was incorporated on December 7, 1916, and has no documents giving the information, it has no knowledge, but upon information and belief answers Yes.

Interrogatory No. 16.

Produce a duly certified copy of the file wrapper and contents of application for Letters Patent of the United States, Serial No. 872,470, referred to as "Aqueous Extract of Oil" in the bill of sale to plaintiff from Minerals Separation American Syndicate (1913), Limited.

Note.—In lieu of a duly certified copy, give defendant's counsel an order and power addressed to the Commissioner of Patents to inspect and make copies of the file wrapper and contents of said application.

(a) If said application was filed in the name of Henry Livingstone Sulman, is he the same Henry Livingstone Sulman hereinbefore inquired about and one of the joint patentees of the patent in suit No. 962,678?

Answer to Interrogatory No. 16.

Plaintiff objects to this interrogatory upon the ground that the defendant is not entitled to the document requested and that the contents of the same are immaterial and irrelevant to any issue herein, but plaintiff will give defendant's counsel the order and power requested.

With respect to (a) the answer is Yes.

Interrogatory No. 17.

Is said Arthur Howard Higgins the same Arthur Howard Higgins named or described in Letters Patent of Great Britain No. 26,852 of 1908?

(a) If so, when did said Higgins next prior to December 10, 1908, leave England for Australia and when did he next thereafter arrive in England?

(b) Produce the original communication from said Higgins upon which the provisional specification of British Patent No. 26,852 of 1908 was based.

(c) Produce each and every communication relating to the subject matter of British Patent No. 26,852 of 1908, and to the subject matter of the patent in suit No. 962,678, between said Higgins and (1) Minerals Separation, Limited, (2) said Sulman, and (3) said Greenway.

Answer to Interrogatory No. 17.

Since plaintiff was incorporated on December 7, 1916, and has no documents giving the information, it has no knowledge, but upon information and belief answers Yes as to the first paragraph of said interrogatory.

With respect to (a), since plaintiff was incorporated on December 7, 1916, and has no documents giving the information, it has no knowledge and is without information except as has appeared in the testimony in the suits above referred to.

With respect to (b) and (c), this part of the interrogatory is objected to as an attempt on the part of the defendant to obtain from the plaintiff information in respect of evidence or testimony which plaintiff may use in support of plaintiff's case, and as not a legitimate use of interrogatories to obtain discovery to which defendant is entitled.

Interrogatory No. 18.

Is said Henry Livingstone Sulman the same Henry Livingstone Sulman who obtained Letters Patent of the United States No. 955,012, dated April 12, 1910, and (with said Picard) Letters Patent of Great Britain No. 28,173 of 1908?

(a) Did Minerals Separation, Limited, obtain German Patent No. 226,096 for an invention substantially corresponding with the supposed invention of said United States Letters Patent No. 955,012 and British Patent No. 28,173 of 1908?

Answer to Interrogatory No. 18.

Since plaintiff was incorporated on December 7, 1916, and has no documents giving the information, it has no knowledge, but upon information and belief answers Yes as to the first paragraph of the interrogatory.

With respect to (a), since plaintiff was incorporated on December 7, 1916, and has no documents giving the information, it has no other or further knowledge than can be obtained from a copy of said German patent, and

furthermore said interrogatory is objectionable as calling upon the plaintiff to make a comparison or a determination with respect to different documents which it is not the right of the defendant to require plaintiff to make.

Interrogatory No. 19.

Did said Sulman, or said Higgins, or said Greenway or Minerals Separation, Limited, make application for patent in Germany for any of the supposed inventions described in British Patents Nos. 26,852 of 1908, 28,173 of 1908, and 2,359 of 1909?

(a) If so, what Letters Patent of Germany were granted on any such applications?

(b) With respect to each and every such application so filed in Germany and upon which no patent was granted, produce a true, correct and complete copy of the specifications and claims, if any, and the drawings, if any, of the application, and each and every of the letters and correspondence to and from the German Patent Office in connection therewith.

Answer to Interrogatory No. 19.

Since plaintiff was incorporated on December 7, 1916, and has no documents giving the information, and has no such documents as are called for in this interrogatory, it therefore cannot produce the same or give the information asked for.

Interrogatory No. 20.

Were said Sulman or said Greenway, or either of them, in Australia (1) during 1908, and (2) during 1909, and if so, give the precise dates when either or both (1) left England and arrived in Australia and (2) left Australia and arrived in England.

Answer to Interrogatory No. 20.

Since plaintiff was incorporated on December 7, 1916, and has no documents giving the information, it

has no knowledge and no information except as appears in the testimony of Henry L. Sulman in the suit against Hyde above referred to.

Interrogatory No. 21.

Produce each and every report and communication, not already called for herein, relating to any and all work in connection with the development and/or practice of the processes described in the patent in suit, No. 962,678, and in British Patents No. 26,852 of 1908; No. 28,173 of 1908, and No. 2,359 of 1909, made by, under the direction of, or to said Sulman, said Greenway, said Higgins, said Stevens and Minerals Separation, Limited, including the following reports to Minerals Separation, Limited:

(1) Tests using carbolic acid, dated 11-12-08 (including laboratory reports dated 8-12-08; 9-12-08);

(2) Further tests using carbolic acid, dated 11-12-08 (including laboratory reports entitled "Results of Tests on Frothing Without Oil");

(3) Further tests using phenol in place of oil dated 23-12-08 (including laboratory reports dated 13-12-08; 16-12-08; 18-12-08);

(4) Tests using various reagents in place of oil, dated 30-12-08;

(5) Experiments for obviating the addition of acids to pulps, dated 2-1-09;

(6) Experiments on frothing without the addition of oil to pulp, dated 4-1-09;

(7) Report dated 6-1-09;

(8) Experiments for obviating the addition of either acid or oil to pulps, dated 9-1-09;

(9) Experiments with amyl alcohol and amyl acetate, dated 9-1-09;

(10) Experiments for obviating either the addition of acid or oil to pulps, dated 12-1-09;

(11) Experiments for obviating the addition of either oil or sulphuric acid to pulps, dated 16-1-09;

(12) Reports dated 18-1-09;

(13) Report on bottle tests, dated 24-1-09;
(14) Report on bottle tests, dated 25-1-09;
(15) Report on bottle tests, dated 28-1-09;
(16) Report on bottle tests, dated 1-2-09;
(17) Report dated 3-2-09;
(18) Report on bottle tests, dated 12-2-09;
(19) Report dated 4-2-09;
(20) Report dated 5-2-09;
(21) Report on bottle tests, dated 28-2-09;
(22) Report dated 10-3-09;
(23) Report dated 12-3-09;
(24) Reports dated 15-3-09;
(25) Report dated 25-3-09;
(26) Report dated 30-3-09;
(27) Report dated 2-6-09;
(28) Report dated 7-6-09;

Note.—In connection with each report or communication produced in answer to this interrogatory state

(a) By whom the report or communication was made,

(b) By whom and under whose direction the various tests and experiments referred to therein were made, and

(c) The dates when such reports or communications were made and such tests and experiments were performed.

Answer to Interrogatory No. 21.

Plaintiff objects to this interrogatory in its entirety as an attempt on the part of the defendant to obtain from the plaintiff information in respect of evidence or testimony which plaintiff may use in support of plaintiff's case, and as not a legitimate use of interrogatories to obtain discovery to which defendant is entitled.

Interrogatory No. 22.

With respect to each of the British patents and applications therefor identified below produce true, correct and complete copies of each and every of the letters and corre-

spondence to and from the British Patent Office in connection therewith,

(a) No. 26,852 of 1908,
(b) No. 28,173 of 1908,
(c) No. 2,359 of 1909.

Answer to Interrogatory No. 22.

Plaintiff cannot produce the documents called for as it has not the same.

Interrogatory No. 23.

With respect to each of the Australian patents and applications therefor identified below produce true, correct and complete copies of each and every of the letters and correspondence to and from the Australian Patent Office in connection therewith.

(a) 13,947 of 1909,
(b) 15,970 of 1909,
(c) 16,568 of 1909,
(d) 16,601 of 1909.

Answer to Interrogatory No. 23.

Plaintiff cannot produce the documents called for as it has not the same.

Interrogatory No. 24.

Are said Sulman, said Higgins and said Greenway, herein inquired about, the persons of the same names, respectively, described as joint inventors in the patent in suit No. 962,678, and named or described in the British and Australian patents enumerated in Interrogatories Nos. 22 and 23, respectively?

Answer to Interrogatory No. 24.

Since plaintiff was incorporated on December 7, 1916, and has no documents giving the information, it has no knowledge, but upon information and belief answers Yes.

Interrogatory No. 25.

Is the said Greenway, herein inquired about, the same Greenway named in Letters Patent of the United States No. 1,099,699, dated June 9, 1914, and who executed on February 13, 1914, an affidavit of record in the file wrapper and contents of said United States patent?

Answer to Interrogatory No. 25.

Yes.

Interrogatory No. 26.

What is the source of the flotation agent known as "M. S. F. O." (Minerals Separation Fuel Oil) supplied the Braden Copper Co. by or with the knowledge and consent of Minerals Separation, Limited, its officers or agents?

(a) When was this flotation agent first so supplied the Braden Copper Co.?

(b) When, to the knowledge of Minerals Separation, Limited, its officers, employees, or agents, was this flotation agent (under the same or any other name) first used in any process of concentrating ores by flotation, and state in what process?

(c) In what respects, if any, does this flotation agent differ from the material known as Blast Furnace Oil?

Answer to Interrogatory No. 26.

Plaintiff has no knowledge upon the subject-matter inquired of to enable it to answer this interrogatory.

Interrogatory No. 27.

What date will the plaintiff rely upon at the trial as

(a) The date of conception of the alleged invention defined by the claims enumerated in paragraph *Eighth* of the supplemental and amended bill of complaint herein?

(b) The date when the said alleged invention was first disclosed to others;

(c) The date when the first written description of the said alleged invention was made;

(d) The date when the said alleged invention was first actually reduced to practice?

Answer to Interrogatory No. 27.

This interrogatory is objectionable and is objected to because it calls upon the plaintiff to state what legal position it intends to take and does not call upon plaintiff for an answer giving facts to support a defence, and further is objected to as an attempt on the part of the defendant to obtain from the plaintiff information in respect of evidence or testimony which plaintiff may use in support of plaintiff's case, and as not a legitimate use of interrogatories to obtain discovery to which defendant is entitled.

The plaintiff has made the above answers without requesting preliminary rulings upon the timeliness of the presentation of the interrogatories or as to their admissibility, for the purpose of expediting the trial of the suit, but makes each of said answers, wherever an objection would be applicable, subject to and reserving its right to object upon any ground to the admissibility of any document referred to or produced or of any evidence referred to in any prior suit.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,

By SETH GREGORY,
President.

CLERK'S DOCKET ENTRY JUNE 6, 1923.

Upon oral presentation by counsel each and every of plaintiffs' objections to the interrogatories was sustained, and exceptions to defendant were allowed in each case.

IN THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

DEFENDANT'S MOTION FOR FURTHER PARTICULARS.

Now comes the defendant, Magma Copper Company, and moves for an order of this Court, under the provisions of Equity Rule No. 20, directing the plaintiff to serve upon defendant's solicitors not later than June 18, 1923, a bill of particulars setting forth fully, particularly and specifically, the following:

Specify:

(a) The date of conception of the alleged invention defined by the claims enumerated in paragraph *Eighth* of the supplemental and amended bill of complaint.

(b) The date when the said alleged invention was first disclosed to others;

(c) The date when the first written description of the said alleged invention was made;

(d) The date when the said alleged invention was first actually reduced to practice.

MAGMA COPPER COMPANY,
Defendant.
By WOODMAN, WHITEHOUSE & LITTLEFIELD,
Its Solicitors.

WILLIAM H. DAVIS,
Of counsel.

Dated New York, N. Y., June 8, 1923.

Service of and receipt of copy of the foregoing motion is hereby acknowledged this 8th day of June, 1923.

HENRY D. WILLIAMS,
Of counsel for Plaintiff.

IN THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

ORDER GRANTING DEFENDANT'S MOTION FOR FURTHER PARTICULARS.

The foregoing motion having been filed *nunc pro tunc* as of June 6th, 1923, now, after hearing oral arguments of counsel for the plaintiff and for the defendant on June 6th, 1923, and after due consideration thereof, it is hereby

DIRECTED AND ORDERED *nunc pro tunc* as of June 6th, 1923, that the plaintiff serve upon defendant's solicitors not later than June 18th, 1923, a bill of particulars setting forth fully, particularly and specifically, the following:

(a) The date of conception of the alleged invention defined by the claims enumerated in paragraph *Eighth* of the supplemental and amended bill of complaint.

(b) The date when the said alleged invention was first disclosed to others.

(c) The date when the first written description of the said alleged invention was made.

(d) The date when the said alleged invention was first actually reduced to practice.

JOHN A. PETERS,
District Judge.

Dated this 12th day of June, 1923.

IN THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE DISTRICT OF MAINE.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

PLAINTIFF'S BILL OF PARTICULARS.

Pursuant to defendant's motion for further particulars served June 8th, 1923, and the Order of Court granting the same, the plaintiff particularizes as follows:

(a) That the plaintiff will in this case rely upon the date of on or about the first of May, 1908, as the date of conception of the invention pointed out and claimed in the claims enumerated in paragraph *Eighth* of the suppiemental and amended bill of complaint.

(b) That the plaintiff will in this case rely upon the same date as the date when the said invention was first disclosed to others.

(c) That the plaintiff will in this case rely upon the provisional specification of British Patent 2359 of 1909, dated February 1, 1909, and filed in the British Patent Office on the same day, as the first written description of said invention, said description having been written on or about that date.

(d) That the plaintiff will in this case rely upon the date of on or about December 8th, 1908, as the date when the said invention was first actually reduced to practice.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Plaintiff,
By SIDNEY ST. F. THAXTER,
Its Solicitor.

Dated, New York, N. Y.,
June 18th, 1923.

HENRY D. WILLIAMS,
WM. HOUSTON KENYON,
LINDLEY M. GARRISON,

Of Counsel.

Service of and receipt of a copy of the foregoing bill of particulars is hereby acknowledged this 18th day of June, 1923.

MERTON W. SAGE.
Counsel for Defendant.

IN THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

NOTICE OF AMENDMENT TO ANSWER.

Henry D. Williams, Esq.,
61 Broadway,
New York, N. Y.

Dear Sir:

PLEASE TAKE NOTICE that at the trial of this cause we shall rely upon the additional anticipatory patents and publications enumerated in the attached motion to amend the defendant's answer and shall urge the additional defenses set forth in the said motion.

The attached motion will be presented just before the trial of the cause at Bangor, Maine, on June 25, 1923.

WILLIAM H. DAVIS,
Of Counsel for Defendant.

New York, N. Y., June 15, 1923.

Service of the foregoing notice and receipt of copy of the motion is hereby acknowledged this eighteenth day of June, 1923.

HENRY D. WILLIAMS,
Of Counsel for Plaintiff.

IN THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

DEFENDANT'S MOTION TO AMEND ANSWER

And now comes the defendant in the above entitled cause and prays leave of the Court to amend its answer to the supplemental and amended bill of complaint as hereinafter particularly specified.

I.

In paragraph 9, after the recitation of the four German patents, the defendant amends by inserting the following:

NEW ZEALAND PATENTS AND PUBLICATIONS.

19,633 of 1905	Sulman, Picard, Ballot.

The complete specification and drawings of New Zealand patent No. 19,633, of 1905, as originally filed and accepted and published in the "New Zealand Gazette Supplement," 1905-1906, issue of July 27th, 1905, page 1824.

MEXICAN PATENTS.

3642 of 1904	Cattermole, Sulman, Picard
4907 of 1905	Sulman, Picard, Ballot
5561 of 1906	Sulman, Picard, Ballot

II.

In paragraph 9, after the paragraph designated "(E)," the defendant amends by inserting the following:

F. That the patentees Sulman, Greenway & Higgins falsely made oath that they believed themselves to be the inventors of the subject matter of the said letters patent, or of so much thereof as the defendant is charged with infringing, when in fact at the date of filing the application on which the said letters patent in suit were granted, they, or some, or all of them, knew that the said subject matter was already known individually to the said Higgins and the said Sulman, each of whom had previously individually filed applications for letters patent therefor in Great Britain.

G. That if any claim or claims of the said letters patent in suit can be construed to cover or include any subject matter used by the defendant, then the said letters patent have to that extent been surreptitiously or unjustly obtained for that which had in fact been invented by the said Sulman or the said Higgins, each of whom was using reasonable diligence in adapting and perfecting the same.

MAGMA COPPER COMPANY

By WILLIAM H. DAVIS,
Of Counsel.

Dated June 15, 1923.

IN THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

ORDER TO AMEND ANSWER.

And now, to wit, this twenty-fifth day of June, A. D. 1923, upon motion of William H. Davis, Esq., of counsel for defendant, it is

ORDERED BY THE COURT that the defendant's motion to amend its answer to the supplemental and amended bill of complaint be granted, and that the amendments as set forth in the motion be allowed, and the clerk of the court is hereby ordered to file the same as of the date of this order as amendments to the aforesaid original answer.

JOHN H. PETERS,
U. S. District Judge,

June 18, 1923.

William H. Davis, Esq.,
Merton W. Sage, Esq.,
165 Broadway,
New York City, N. Y.

Dear Sirs:

At the trial of the suit of Minerals Separation North American Corporation v. Magma Copper Company we shall limit the charge of infringement to claims 1 and 2 of the patent in suit, and will apply for leave to amend accordingly paragraph *Eighth* of the supplemental and amended bill of complaint at the opening of the trial.

Very truly yours,
HENRY D. WILLIAMS,
WM. HOUSTON KENYON,
LINDLEY M. GARRISON.

IN THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

NOTICE UNDER EQUITY RULE No. 58.

Henry D. Williams, Esq.,
61 Broadway,
New York, N. Y.

Dear Sir:

Pursuant to the provisions of Equity Rule No. 58 (last paragraph) the defendant now calls upon the plaintiff to admit in writing the execution or genuineness of the following described documents, letters, or writings, saving all just exceptions, and if such admissions be not made within five days after the service hereof, the defendant will make due application to the court for the cost of proving the said documents, letters, or writings.

1. The genuineness of the treatise entitled "*The Theory of 'Concentration Processes Involving Surface-Tension'*", produced by Theodore J. Hoover (during the taking of his testimony *de bene esse* beginning January 3, 1922, which testimony has, by stipulation, been made available in the instant case), which treatise was delivered to the said Hoover by Henry Livingstone Sulman during the year 1907.

2. The genuineness of the *Provisional Specification* dated the tenth day of December, 1908, and filed in the British Patent Office on December 10, 1908, and printed as a part of the

regular printed copy of British Patent No. 26,852 of 1908 for "Improvements in or relating to the Concentration of Ores" (a communication from Arthur Howard Higgins, of Broken Hill, New South Wales, Australia).

3. The genuineness of the *Provisional Specification* dated the twenty-fourth day of December, 1908, and filed in the British Patent Office on December 24, 1908, and printed as a part of the regular printed copy of British Patent No. 28,173 of 1908 for improvements in or relating to the concentration of ores.

4. The genuineness of the letter addressed to "Dear S. & P." and signed "C. V.", photostat copy of which letter is attached hereto.

Note.—In connection with this letter, the plaintiff is asked to admit that "S. & P." mean Sulman and Picard, and that the letter was written by Claude Vautin.

5. The genuineness of the letter addressed to "Dear Mr. Vautin" and signed "*H. K. Picard,*" photostat copy of which letter is attached hereto.

Note.—In connection with this letter the plaintiff is asked to admit that the letter was addressed to Claude Vautin and was written by Hugh Fitzalis Kirkpatrick-Picard.

6. The genuineness of the record in the case of Ore Concentration Company (1905), Limited, and Australasian Ore Concentration Syndicate Limited vs. Sulphide Corporation Limited, as introduced in evidence (Defendant's Physical Exhibit No. 121) in the suit of Minerals Separation Limited vs. Miami Copper Company.

7. The genuineness of the attached papers in the suit of Minerals Separation Limited vs. The Ore Concentration Company (1905) Limited, entitled:

(a) Statement of Claim,

(b) Particulars of Breaches,

(c) Defense,
(d) Particulars of Objections,
(e) Affidavit of Bartram Blount,
(f) Notice of Discontinuance.

8. The genuineness of a report dated "16th May, 1902," addressed to John Ballot, Esq., and signed by *Sulman & Picard,* a copy of which report is in the possession of defendant's counsel and may be seen at any time by plaintiff's counsel.

Dated this fifteenth day of June, 1923.

WILLIAM H. DAVIS,
Of counsel for Defendant.

Service of the foregoing notice and receipt of copy of the same acknowledged this fifteenth day of June, 1923.

HENRY D. WILLIAMS,
Of counsel for Plaintiff.

IN THE DISTRICT COURT OF THE UNITED STATES IN AND FOR THE DISTRICT OF MAINE.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

ANSWER OF PLAINTIFF TO DEFENDANT'S NOTICE UNDER EQUITY RULE No. 58.

William H. Davis, Esq.,
165 Broadway,
New York City.

Dear Sir:

Answering defendant's notice calling upon plaintiff to admit in writing the execution or genuineness of certain alleged documents, letters or writing therein described, and saving all just exceptions and objections to the requests made and to the answers given, plaintiff answers as follows:

1. Plaintiff has no knowledge that would justify it in admitting the genuineness of the document referred to in request numbered 1, but for the purposes of this case will not deny the statement of the witness Theodore J. Hoover in answers to questions 34 to 36 inclusive, and questions 96 and 97 in the deposition of said Theodore J. Hoover which has been stipulated into the instant case.

2. Plaintiff admits that the provisional specification dated the tenth day of December, 1908, and printed as a part of the regular printed copy of British Patent No. 26,852 of 1908 to Minerals Separation, Limited, was signed by Boult, Wade & Tennant as patent agents for Minerals Separation, Limited, and was filed in the British Patent Office on December 10, 1908.

3. Plaintiff admits that the provisional specification dated the twenty-fourth day of December, 1908, and printed as a part of the regular printed copy of British Patent No. 28,173 of 1908 to Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard and John Ballot was signed by Boult, Wade & Tennant as patent agents for said Sulman, Picard and Ballot, and filed in the British Patent Office on December 24, 1908.

4. Plaintiff has no knowledge that would justify it in admitting the genuineness of the alleged letter referred to in request numbered 4 and therefore refuses to admit the same and refuses to answer the note appended to said request.

5. Plaintiff has no knowledge that would justify it in admitting the genuineness of the alleged letter referred to in request numbered 5 and therefore refuses to admit the same and refuses to answer the note appended to said request.

6. Plaintiff admits the genuineness of the record referred to in request numbered 6, subject to comparison thereof with plaintiff's copy of the same record, which plaintiff's counsel has not yet had an opportunity to make.

7. Plaintiff admits the genuineness of the papers referred to in request numbered 7, paragraphs (a) to (d) inclusive and (f), but has no knowledge that would justify it in admitting the genuineness of the paper referred to in paragraph (e) and therefore refuses to admit the genuineness of said paper.

8. Plaintiff refuses to admit the genuineness of the alleged report referred to in request numbered 8 or the accuracy of the alleged copy thereof referred to in said request numbered 8 and exhibited to plaintiff's counsel.

MINERALS SEPARATION NORTH AMERICAN CORPORATION.

By SIDNEY ST. F. THAXTER,
Its Solicitor.

Dated New York, N. Y.
June 23, 1923.

HENRY D. WILLIAMS,
WM. HOUSTON KENYON,
LINDLEY M. GARRISON,
Of Counsel.

Service of and receipt of a copy of the foregoing is hereby acknowledged this twenty-third day of June, 1923.

WM. H. DAVIS,
Counsel for Defendant.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

STIPULATION RE DEFENDANT'S MILL OPERATIONS.

It is hereby stipulated and agreed by and between counsel for the respective parties hereto that the following is a correct statement of mill operations of the defendant, Magma Copper Company's mill at Superior, Arizona, during the last three (3) months of 1919.

A belt conveyor carried the ore from the mill bin to the feed end of a Marcy ball mill rotating at about 20 r. p. m. An average of 1.7 pounds of lime (CaO) per ton of ore were fed into the Marcy mill along with the ore. Water in the customary amount was introduced into the Marcy mill along with the ore and lime. The Marcy mill was designed to grind ore to about twelve mesh. The Marcy mill discharged into the boot of a bucket elevator which elevated the ore, now in the form of an ore pulp, and delivered the same to a twelve-mesh Callow screen. The oversize from the screen was returned to the Marcy mill. The ore pulp passing through the Callow screen was conveyed to Wilfley concentrating tables from which three products were taken, to wit:

(1) concentrate,
(2) middling, and
(3) tailing.

The table concentrate was delivered to an Akins classifier; the resulting coarse concentrate being delivered to a

storage bin for shipment and the overflow was delivered to Goldfield thickener tanks.

The table middling was delivered to the boot of the aforementioned bucket elevator.

The table tailing was delivered to the boot of a second bucket elevator which elevated and delivered the tailing to a drag classifier.

The overflow product of the drag classifier was minus sixty mesh and was delivered to the upper pneumatic flotation cells.

The oversize from the drag classifier was delivered to a sixty-mesh Chalmers and Williams tube mill, rotating at about 20 r. p. m. and discharging into the boot of the second bucket elevator.

A solution of alpha-naphthylamin (X-cake) in water was introduced directly into the upper flotation rougher cells along with the overflow from the drag classifier.

The overflow froth from the roughers was conveyed to the upper flotation cleaner cell.

The tailings from the roughers were conveyed to a second set of Wilfley tables.

The overflow froth from the upper flotation cleaner cell was a finished concentrate, which was conveyed to thickeners and filters.

The tailings from the upper flotation cleaner cell were returned to the boot of the second elevator.

From the second set of Wilfley tables three products were taken, to wit:

(1) concentrate,
(2) middling, and
(3) tailing.

The concentrate was conveyed to the thickeners and filters. The middling was returned to the boot of the second elevator; and the tailing was conveyed to the lower flotation rougher cells.

The froth overflow of the lower flotation rougher cells was conveyed by a diaphragm pump to a lower flotation cleaner cell. The tailing from the lower flotation rougher cells was conveyed to the tailing discharge pond.

The froth overflow from the lower flotation cleaner cell was conveyed to the concentrate thickener and filters, and the tailing was returned by a diaphragm pump to the head of the lower rougher cells.

The pneumatic flotation cells were the well-known Callow pneumatic flotation cells patented in the United States, Patent No. 1,329,335, dated January 27, 1920, granted to the Pneumatic Process Flotation Company.

The solution of alpha-naphthylamin in water employed as aforesaid by the Magma Copper Company contained approximately one part by weight of alpha-naphthylamin in 1000 parts of water. This solution was added to the aforesaid first pneumatic flotation cells in such amount that approximately 0.48 pounds of alpha-naphthylamin were introduced into said first pneumatic flotation cells for each ton (dry weight) of ore introduced into said cells. The use of alpha-naphthylamin in the concentration of ores by flotation is covered by United States Letters Patent 1,228,183, granted on May 29, 1917, to Metals Recovery Company, as assignee of Harry P. Corliss.

The only fresh water available was that which comes from the mine. The mine water was mixed with the return circuit water to supply the water used in the mill.

The ore treated as aforesaid at the mill of the Magma Copper Company is a copper sulfide ore containing varying amounts of bornite, chalcopyrite, pyrite and chalcocite. The composite of samples of mill heads for the last six months of 1919 assayed as follows:

CU	AG	AU	PB	ZN	CaO	MgO	S	H_2O	Fe	INS	SiO_2	AL_2O_3	MN
%	OZ	OZ	%	%	%	%	%	%	%	%	%	%	%
4.08	3.90	0.05	0.40	1.9	0.50	0.51	15.24	0.00	13.75	62.20	45.40	12.10	0.23

The ore delivered to the first Wilfley concentrating tables averaged about 3.5 per cent. copper (Cu). The overflow of the aforesaid drag classifier contained between 16 per cent. and 17 per cent. of solids. The ore in this overflow averaged about 2.2 per cent. copper (Cu).

The average volume of air per square foot of flotation area was between 7 and 9 cubic feet per minute in the roughers and about 4 cubic feet per minute in the cleaners.

The average blower pressure was 3.8 pounds per square inch.

The attached blue print entitled "Magma Copper Company Mill Flow Sheet (1919)," is a correct copy of the flow sheet of the mill throughout the last three months of 1919.*

The attached nine (9) blue prints of mill data are correct copies of the Daily Mill Reports (Final) and Summaries for October, November and December, 1919.**

HENRY D. WILLIAMS,
Of Counsel for Plaintiff.

WILLIAM H. DAVIS,
Of Counsel for Defendant.

Dated Superior, Arizona, May 3, 1923.

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*See Plaintiff's Exhibit Book, page 41.

**See Plaintiff's Exhibit Book, page 42.

IN THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF MAINE, SOUTHERN DIVISION.

IN EQUITY ON LETTERS PATENT No. 962,678.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

Federal Court House, Bangor, Maine,
June 25th 1923, 2 o'clock p. m.

Before Hon. JOHN A. PETERS, *District Judge.*

Appearances: HENRY D. WILLIAMS, ESQ., WILLIAM HOUSTON KENYON, ESQ., LINDLEY M. GARRISON, ESQ., SIDNEY ST. F. THAXTER, ESQ., HARRY C. LEWIS, ESQ., of counsel for plaintiff;
WILLIAM H. DAVIS, ESQ., ALBERT S. WOODMAN, ESQ., JOHN F. NEARY, ESQ., MERTON W. SAGE, ESQ., of counsel for defendant.

THE COURT: You are all ready, I think?

MR. WILLIAMS: Yes, sir.

We notified the defendant that we would move to amend the bill of complaint, by limiting the charge of infringement to claims 1 and 2 of the patent in suit, and to that end we move to amend paragraph Eighth of the supplemental and amended bill of complaint by striking out the numerals and word "3, 4, 5, 6, 7 and 8," and inserting an "and" between 1 and 2, so that the clause reads that the defendant did "install apparatus for and carry on the use of the said process of ore con-

centration as described in the specifications and pointed out and claimed in claims 1 and 2 of the aforesaid Letters Patent No. 962,678."

THE COURT: I take it there is no objection?

MR. DAVIS: No, sir.

If your Honor please, we have given notice of a motion to amend the answer, by setting up certain specified patents of New Zealand and Mexico. Those patents were represented by United States Patents for the same invention, and also by adding to paragraph 9, or after paragraph 9, the following:

"That the patentees, Sulman, Greenway and Higgins, falsely made oath that they believed themselves to be the inventors of the subject matter of the said letters patent, or of so much thereof as the defendant is charged with infringing, when in fact at the date of filing the application on which the said letters patent in suit were granted, they, or some of them, or all of them, knew that the said subject matter was already known individually to the said Higgins and the said Sulman each of whom had previously individually filed applications for letters patent therefor in Great Britain."

"G. That if any claim or claims of the said letters patent in suit can be construed to cover or include any subject matter used by the defendant, then the said letters patent have to that extent been surreptitiously or unjustly obtained for that which had in fact been invented by the said Sulman or the said Higgins each of whom was using reasonable diligence in adapting and perfecting the same."

THE COURT: No objection?

MR. WILLIAMS: No objection.

MR. WILLIAMS'S OPENING STATEMENT ON BEHALF OF PLAINTIFF.

(See Plaintiff's Oral Arguments).

MR. DAVIS'S OPENING STATEMENT ON BEHALF OF DEFENDANT.

(See Defendant's Oral Arguments).

Second day.
Trial resumed.

Bangor, Me., June 26th, 1923.

(Met pursuant to adjournment.)

(Parties present as before.)

MR. WILLIAMS: I offer in evidence a copy of the patent in suit, and we have made a general stipulation that printed Patent Office copies of patents shall be received in evidence with the same force and effect as certified copies.

I think I had better read the stipulation:

"IT IS HEREBY STIPULATED AND AGREED that at the trial of the above-entitled cause printed Patent Office copies of specifications and drawings of Letters Patents of the United States, Great Britain and other foreign countries may be introduced and shall be received in evidence with the same force and effect as original letters patents or duly certified copies thereof, as to all the facts set forth in said printed copies, including the dates of filing of the applications for said letters patents and the issuance thereof, subject to correction by other proof.

"IT IS FURTHER STIPULATED AND AGREED that statements in the printed Official Journal of the British Patent Office as to the sealing dates of British patents shall be accepted as prima facie proof thereof, subject to correction by other proof.

"IT IS FURTHER STIPULATED AND AGREED that photostat copies of publications may be introduced and shall be received in evidence with the same force and effect as

the originals, and that such publications were published on the respective dates they bear purporting to be the date of publication."

That is to be filed, of course.

THE COURT: The stipulation does not have to be marked in evidence.

MR. WILLIAMS: No. The patent in suit is to be marked "Plaintiff's Exhibit 1, Patent in Suit."

(Received in evidence and marked "Plaintiff's Ex. No. 1.")

MR. WILLIAMS: In the bill of complaint we set out in full the title, and the defendant puts us upon proof. I have all the documents that enter into it. I am going to ask if the defendant will stipulate title, that the title in the patent in suit is in the plaintiff?

MR. DAVIS: No, we will not.

MR. WILLIAMS: Then I will have to prove title. The first document that I will offer in evidence is the certificate. Will you admit the incorporation?

MR. DAVIS: Yes.

MR. WILLIAMS: You will admit that the plaintiff is a corporation as alleged?

MR. DAVIS: That is, the Minerals Separation North American Corporation?

MR. WILLIAMS: The plaintiff, Minerals Separation North American Corporation.

MR. DAVIS: We will admit that it is a corporation.

MR. WILLIAMS: As alleged in the bill of complaint?

MR. DAVIS: Yes.

MR. WILLIAMS: I offer in evidence an assignment from Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, of London, England, to Minerals Separation, Limited, of London, England, bearing date September 26, 1910, acknowledged by Messrs. Sulman and Higgins, before the United States Consul, at London, on August 26, 1910, acknowledged by Mr. Greenway before the United States Consul at Melbourne, Victoria, Australia, on September 26, 1910; and this is an assignment of the whole right,

title and interest in the patent in suit and contains a certificate of record by the United States Patent Office, as received and recorded August 28, 1911.

MR. WILLIAMS: This I offer in evidence as "Plaintiff's Exhibit No. 2, assignment, Sulman, Greenway and Higgins to Minerals Separation, Limited."

(Received in evidence and marked "Plaintiff's Ex. No. 2.")

MR. WILLIAMS: The next document is an agreement to assign, from Minerals Separation, Limited, to Minerals Separation American Syndicate (1913) Limited, bears date July 8, 1913, is executed in the manner of British Transfers with the seals of the respective corporations, the signatures of two directors and of the secretary of the corporation. There are numerous documents attached to it which are not offered in evidence because they are unnecessary, and I would like to know whether the defendant will permit a printed copy of this document to be offered in evidence.

MR. NEARY: What is the agreement that you refer to?

MR. GARRISON: June 8th agreement, Companies Consolidation Act.

MR. DAVIS: If your Honor please, I suggest that it might save a lot of time if Mr. Williams would just offer these title documents in evidence without attempting to go into them in detail now, and give us an opportunity to look them over and then we can come to an agreement.

THE COURT: I think that is a valuable suggestion. Perhaps that will simplify the matter, after they examine it.

MR. WILLIAMS: I offer the document then bodily.

THE COURT: You can offer them and have them identified and numbered.

MR. WILLIAMS: "Plaintiff's Exhibit No. 3, Agreement to Assign, Minerals Separation, Limited, to Minerals Separation American Syndicate (1913) Limited."

(Received in evidence and marked "Plaintiff's Ex. No. 3.")

MR. WILLIAMS: I think that I will limit the offer in evidence to the document, although this other attached copy of

the Companies Consolidation Act of 1908 is offered for the inspection of the defendant, and if the defendant wants to put that in evidence, the defendant may do so. I will not lumber up the record with it.

THE COURT: Your offer is confined to the first document?

MR. WILLIAMS: To the agreement, to the first document.

Now the next document is a bill of sale from Minerals Separation American Syndicate (1913) Limited to Minerals Separation North American Corporation, the present plaintiff. The original document is bound in a book with numerous other documents. I have printed copies. I do not wish to have this book marked up. Will the defendant consent to have a printed copy marked in evidence if given an opportunity for comparison and objection?

MR. DAVIS: Yes.

MR. WILLIAMS: This copy is offered in evidence as "Plaintiff's Exhibit 4, being Bill of Sale Minerals Separation American Syndicate (1913) Limited to Minerals Separation North American Corporation."

MR. DAVIS: Subject to correction and comparison.

THE COURT: The reception is deferred subject to comparison.

(The paper was received in evidence and marked "Plaintiff's Exhibit No. 4.")

MR. WILLIAMS: The next document is an assignment from Minerals Separation, Limited, to the Minerals Separation North American Corporation of the patent in suit and two other patents.

This document bears date June 1, 1922; it was acknowledged June 1, 1922, and the acknowledgment certified by the United States Consul at London. It was recorded in the Patent Office on June 21, 1922.

It is an assignment of the patent in suit and of all right of action, claim and demand under it.

And I may say that this assignment divested the British Corporation, Minerals Separation, Limited, of interest in the subject matter of this suit; and following this assignment the amended bill of complaint was filed.

I offer in evidence the document as "Plaintiff's Exhibit 5, Assignment, Minerals Separation, Limited, to Minerals Separation North American Corporation."

(Received in evidence and marked "Plaintiff's Ex. No. 5.")

PLAINTIFF'S PROOFS.

JAMES WILDING, called as a witness on behalf of the plaintiff, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. WILLIAMS:

Q. 1. Please state your name, age, residence and occupation.

A. James Wilding; residence, New York; age, fifty-three; occupation, metallurgist.

Q. 2. By whom are you now employed as a metallurgist?

A. By the Minerals Separation North American Corporation.

Q. 3. That is the plaintiff in this action, as you understand?

A. Yes.

Q. 4. What have been your experience and training as a metallurgist?

A. I began my professional education by serving a three years apprenticeship to Mr. Edward Davies, Fellow of the Institute of Chemistry and of the Chemical Society of Great Britain, a consulting chemist with a considerable analytical business. After the period of that apprenticeship, I passed two years as a special student of metallurgy at the Freiberg Mining Academy in Saxony. Thereafter I was for a considerable period in Mexico, in the service of a number of mining companies, and also in independent work, all of which was either of a metallurgical or of a mining character, or connected therewith. After leaving Mexico in 1913—some months after leaving Mexico in 1913, I entered the service of Minerals Separation American Syndicate (1913) Limited, the prede-

cessor of the company in whose employ I am now. Since 1913, I have been continously in the service of that company and its successor, the present Minerals Separation North American Corporation.

Q. 5. And what, in general, has been the nature of the work that you have done for these two companies in succession during the past ten years?

A. During the first portion of that period my work was the testing of ores with regard to their susceptibility to flotation, and, in the field, installing plants, or educating operators to run those plants. Later my main work has been in connection with litigation in which the company has been engaged.

Q. 6. And these plants that you installed, or assisted in installing and instructed operators in regard to, were what kind of plants?

A. They were small plants of some 50 tons capacity, usually installed for the purpose of trying out the process at the mines themselves.

Q. 7. And then were there larger plants that were actually operating on a large scale, under your general domain?

A. There were.

Q. 8. And the process carried out in all these plants was what kind of a process?

A. It was the air-froth flotation process of ore-concentration.

Q. 9. Have you read the stipulation in this case, dated Superior, Arizona, May 3, 1923?

A. Yes.

MR. WILLIAMS: This stipulation has been filed, but I think I should offer it in evidence, and I offer it in evidence as Plaintiff's Exhibit No. 6, the stipulation as to defendant's operations.

(Received in evidence and marked "Plaintiff's Ex. No. 6.")

MR. WILLIAMS: Now, I read in this stipulation, Mr. Wilding, that a belt conveyor carried the ore from the mill bin to the feed end of a Marcy ball mill, rotating at about 20 r. p. m.

Q. 10. Generally, what is described by the words "belt conveyor?"

A. It is a continuous belt, running over two pulleys, usually supported in between the two pulleys at the extremities, by idler pulleys, and is used to convey in this case ore, which drops on to the belt at one end and is discharged over the pulley at the other end.

Q. 11. What generally is described by a "Marcy ball mill"?

A. A Marcy ball mill is a cylinder, the ratio of whose length to the diameter is nearly one to one—something like that—in which there are a number of steel or iron balls. It receives ore, usually accompanied by water, and crushes that ore. The ore is received through one trunnion and is discharged through the other trunnion.

Q. 12. The stipulation says "Water in the customary amount was introduced into the Marcy mill along with the ore and lime." What does that mean?

A. I take it that in this case it would not exceed in weight the amount of the ore fed to the mill. It might be less.

Q. 13. The statement is made that the Marcy mill was designed to grind ore to about 12-mesh. What is 12-mesh, roughly?

A. The meshes of a 12-mesh sieve are about one-twentieth of an inch in linear dimensions.

Q. 14. And when you say one-twentieth of an inch in linear dimensions, do you mean a square the sides of which are about one twentieth of an inch each?

A. Yes, sir.

By THE COURT:

Q. 15. You mean 144 meshes to the square inch—144 meshes in a square inch of space?

A. Yes, sir, of course.

By MR. WILLIAMS:

Q. 16. It is true, is it not, that in the European standards they do not always take the linear dimensions for meshes, and they sometimes state them in the square—the number of holes in a square?

A. I have seen them stated that way.

Q. 17. But in this country it means the linear dimensions; is that right?

A. Yes.

Q. 18. The stipulation says "The Marcy mill discharged into the boot of a bucket elevator which elevated the ore now in the form of an ore pulp and delivered the same to a 12-mesh Callow screen." What is the boot of a bucket elevator?

A. A receptacle at the foot of the elevator which receives the material to be elevated.

Q. 19. And what is the operation of a bucket elevator?

A. A bucket elevator is usually—in this case it was, I believe—a belt and bucket elevator, a continuous belt running almost vertically or little inclined therefrom over a large pulley at the upper end and around a pulley in the boot. Attached to the belt are scoops or buckets. They are more scoops than buckets, which lift and scoop up the material in the boot and raise it over the upper pulley, where it is discharged into a receptacle built close to the running line of the belt.

Q. 20. Now, "Delivered to a 12-mesh Callow screen:" Will you generally describe a 12-mesh Callow screen?

A. The Callow traveling belt screen is a continuous belt of screen cloth placed in horizontal position. It runs over two pulleys or rollers, one at each end. At one end it receives the ore pulp, a part of which passes through the meshes as the belt travels from one pulley or roller to the other and is caught on a tray between the two limbs of the traveling belt; the remainder that does not pass through the meshes is discharged at the further end.

Q. 21. What is that called, the part that is discharged?

A. That is the oversize of that particular mesh.

By THE COURT:

Q. 21-a. What does the word "Callow" mean? Is that the name of the man who invented it?

A. Yes, sir.

By MR. WILLIAMS:

Q. 22. The stipulation says "The oversize from the

screen was returned to the Marcy mill;" generally, for what purpose was it returned to the Marcy mill?

A. To be ground to a size at which it would pass through the meshes of the screen or sieve.

Q. 23. We next have a reference to Wilfley concentrating tables. Wilfley, by the way, is the name of the inventor?

A. Yes.

Q. 24. And generally describe these concentrating tables.

A. The Wilfley concentrating table, in essentials, consists of a plane deck inclined slightly from one side to the other and reciprocated in the direction of its length by the mechanism at one end. The feed comes onto the table at one corner of the end nearest the reciprocating mechanism. It is a so-called ore-pulp, which consists of ground ore in water. The feed spreads out on the surface of the table. Near to that feed end, it quickly loses a good deal of its water, most of it. A considerable portion of the solids settle down onto the surface, and by means of the reciprocating motion are forced to travel in the direction of the motion. The inclination of the table and the wash water that is added in advance of the feed make the lighter particles travel downwards towards the lower edge of the table, the lower side of the table, the heavier particles remaining close to the deck. The result is that the lighter portion is washed off the side, and the heavier portion travels forward and is discharged at the end.

Q. 25. And this heavier portion, what is that called?

A. The concentrates.

Q. 26. And the lighter portion?

A. The tailings.

Q. 27. And is there something in between; and if so, what is it called?

A. There is an overlap in this separation of heavy and light material. In between the clean concentrates and the clean tailings there is always something that is neither one nor the other, that is called middlings.

Q. 28. Now, when you have an ore-pulp containing particles of metalliferous mineral and particles of gangue mixed

with water, if you were to stop it from motion, what would happen to the material carried in the water?

A. It would settle out.

Q. 29. It would settle to the bottom?

A. Yes.

Q. 30. And how are these ore-pulps operated so as to keep these materials, which tend to settle, in suspension in the liquid, generally?

A. You mean in the passage of ore-pulp from one portion of the mill to another?

Q. 31. Yes.

A. They usually flow down launders which have sufficient inclination to give the stream a velocity sufficient to keep the solids in suspension.

Q. 32. What is a launder?

A. A launder is a narrow channel.

Q. 33. Would you call it a long trough?

A. Yes.

Q. 34. And in the machines themselves, aside from the launders, is or is not the ore-pulp usually kept in motion?

A. Yes, sir; in all concentrating machines ore-pulp is in motion, and in the grinding machines.

Q. 35. And in water concentration what is it that determines the separation such as is obtained of the mineral from the gangue?

A. The specific gravity of the mineral is the main factor.

Q. 36. And the settling power in water, would you accept that as somewhat descriptive?

A. Yes.

Q. 37. The stipulation says that the table concentrate was delivered to an Akins classifier. Now, in the first place what does that show as to whether or not the concentrate obtained from these Wilfley tables was a finished product, so far as the concentration is concerned, having in mind, of course, this mill we are talking about?

A. Well, this particular Akins classifier received the table concentrates and divided them into fines and a coarser portion which settled readily. In this particular case the

coarser material was discharged from one end of the classifier and went to the concentrate bins to be shipped to market. The fines overflowed from the classifier with most of the water that accompanied them to that machine, and passed through the launders to settling tanks, that is how I read it.

Q. 38. Now just what is, very generally, an Akins classifier?

A. An Akins classifier is a long trough of hemispherical bottom, closed at one end, open at the other, and set with the bottom inclined to the horizon. In that trough there works a screw which pushes the settled solids up the bottom of the trough and discharges them over the end, comparatively free from the accompanying water. The unsettled solids go off with the greater part of the water from the lower end of the trough.

Q. 39. Would you liken that to the Archimedian Screw?

A. Yes.

Q. 40. Now, the thickener tanks here described are Goldfield thickener tanks. Just state generally what happens in tanks of this kind when this material enters?

A. The solids settle out of the accompanying water, and by one means or another they are separated from that water.

Q. 41. The function of the tanks is to separate what?

A. Separate the solids from the water.

Q. 42. I read that the overflow product of the drag classifier was "minus 60-mesh" and was delivered to the upper pneumatic flotation cells. What is the meaning of "minus 60-mesh?"

A. That is to say that the particles of ore would all pass through a sieve 60-meshes to the linear inch.

Q. 43. And 60-meshes to the linear inch gives about what sized orifices?

A. It would be about one hundredth of an inch.

Q. 44. That is to say the screen would have little squares, about one hundredth of an inch on each side?

A. Yes.

Q. 45. And what would go through that opening would be the minus 60-mesh?

A. Yes.

Q. 46. And this minus 60-mesh product which was delivered to the upper pneumatic flotation cells, what name would you give to that in the mill?

A. In this mill I should call that the flotation feed.

THE COURT: Flotation what?

THE WITNESS: Feed.

Q. 47. That is to say it was the material fed to the flotation plant?

A. Yes.

Q. 48. Now, the stipulation says the over-size from the drag classifier was delivered to a 60-mesh Chalmers & Williams tube mill, rotating at about 20 r. p. m. How do you interpret that 60-mesh Chalmers & Williams tube mill?

A. It is a tube mill which is intended to effect the grinding of the ore to pass a 60-mesh screen—60-mesh hasn't anything to do with the name of the mill.

Q. 49. And a Chalmers & Williams tube mill, describes that generally?

A. It is a long cylinder, with closed ends, receiving feed through one trunnion and discharging it through another. It contains in this case iron or steel balls which effect the grinding of the material. The mill is rotated on its own axis.

MR. WILLIAMS: The defendant's counsel, at the request of plaintiffs' counsel, have delivered to us a working drawing of the Callow cells or Callow pneumatic flotation apparatus which were in use in the defendant's mill at the time of the stipulation. I offer this drawing in evidence, and ask that the defendant stipulate that it is a working drawing of the Callow pneumatic flotation apparatus, such as were installed in the defendant's plant during the three months preceding the commencement of the suit.

MR. DAVIS: It is so stipulated.

(Received in evidence and marked "Plaintiff's Ex. No. 7.")

Q. 50. Have you examined and studied this drawing, Mr. Wilding?

A. Yes.

Q. 51. Are you familiar with the operation of the apparatus that is shown in this drawing?

A. Yes.

Q. 52. Will you briefly describe the construction and operation of this apparatus?

A. This apparatus consists of a long tank, open at the top, the bottom of which is a porous blanket. The bottom is inclined to the horizon. This porous blanket covers a series of compartments into which air is blown. This air passes through the canvas, into the body of the pulp, which has to be treated in that cell, and which is fed into the cell at the shallower end. The passage of air into that body of pulp causes agitation which, in the presence of a mineral-frothing agent, causes the formation above the general surface of the pulp of a mineral-bearing froth. This in the operation of the cell passes continuously over the overflow at the sides of the cells. There it is received in launders and runs to a place where it may be further treated, or settled, or filtered, or in any other way disposed of. The tailings resulting from that operation—that is the residue of the ore—pass out at the deeper end of the cell.

Q. 53. At the right-hand end of the two drawings, which are evidently a plan and a side elevation partly in sections, just describe the feed part. What does it consist of?

A. The feed compartment of the cell is shown in the longitudinal section. It is a compartment wider at the top than at the bottom, and open at the bottom. It receives the feed through a pipe which enters through a cover, and it is simply made by an inclined baffle or board which reaches both walls of the cell. It extends from one wall to the other.

Q. 54. Does all the material that enters the cell have to pass under that feed baffle?

A. Yes, sir.

Q. 55. Now, at the deeper or tailings outlet end: will you describe how the out-flow is regulated?

A. At the deepest point of the cell there is a pocket underneath the bottom. At the bottom of this pocket there is an outlet or orifice. In this orifice works a cone valve, which is

attached to a long rod, which is raised or which falls, and can be raised by a lever attached to a float. The effect of the valve is to regulate the height or the level of the pulp in the cell. If it tends to increase, then the float rises and opens the valve a little wider; then if it tends to lower, the float will sink and the valve with it.

Q. 56. I notice at the top of this rod, extending from the cone valve up to the top of the cell, there is something which looks like a nut. What is that and what is its function?

A. That is a small hand wheel working on a thread, and it is by that means that the level of the pulp is regulated.

Q. 57. That is to say, the rod is threaded and this hand wheel turns on it, and by turning it you lengthen or shorten the rod, practically?

A. That is so.

Q. 58. Now, this float—

MR. WILLIAMS: I do not know whether your Honor recognizes it in the drawing, but I now point it out (indicating). I asked what that thing was and he answered, and I just wanted to get that on the record.

Q. 58. Now, the stipulation says that some of these flotation cells were roughers and some were cleaners, and you have described the operation of the flotation cell, with the discharge of the froth, or what overflows, into concentrates launders, and on to the next operation. Suppose that the next appliance was a cleaner, how would this material go to that cleaner and what would happen in that cleaner cell?

A. The concentrates in this case, I take it, simply flow down launders to the cleaner cells. I do not see any other method of conveyance described.

Q. 59. And what happens in the cleaner cells, the same thing or a different thing?

A. It is the same operation.

Q. 60. And what is the effect of that same operation in the cleaner?

A. It is to separate more of the valueless material which accompanied or was part of the rougher concentrate from the valuable material.

Q. 61. In general practice, when you overflow a froth from a rougher and send it into a cleaner, do you have to add water or is there water enough in the froth overflow?

A. There is plenty of water in the froth overflow, but in order to get a clean concentrate, I add water in my cleaner operation.

Q. 62. That is the usual practice, is it not? Is not that the usual practice?

A. Yes.

Q. 63. So as to make a pulp of the proper consistency in the cleaner cell, is that not right?

A. Yes.

Q. 64. I notice on the flow sheet, which is annexed to the stipulation, that there are numerals in little circles alongside most of the apparatus. What is the significance of those numerals in the flow-sheet?

A. They give the number of machines of the particular type.

Q. 65. For example, the Wilfley tables that first occur in the circuit, there is alongside of them the numeral "4." That means four Wilfley tables?

A. Yes.

Q. 66. And when you have a division of that sort, four pieces of apparatus, how do you manage to carry the pulp to that apparatus?

A. In various ways.

Q. 67. In this instance, as indicated in this flow-sheet?

A. There is no special distributing machine shown, so I should judge that the pulp flowing to the four tables was simply split off, one portion from another, in a launder.

Q. 68. So as to divide it into practically four equal parts?

A. As nearly as possible.

Q. 69. And this numeral "4" means that these four tables are arranged so as to divide the product between them; does it mean that?

A. Yes, I should take it that the tables were in parallel, not in series.

Q. 70. Then in this diagram there is a second set of

Wilfley tables, to which I have not particularly called your attention; and does the diagram indicate three tables in each set arranged in parallel and not in series?

A. Yes; three receive the tailings from two rougher Callow cells, and three receive the tailings from two other rougher Callow cells.

Q. 71. And in order to flow a pulp from two machines and divide that pulp among three machines, generally what do the launders have to do?

A. The tailings from either of these sets of roughers may have been collected in a junction box and may have flowed down a launder to the three Wilfley tables.

Q. 72. And generally, metallurgical practice would mean bringing the two products together and then dividing them into three equal parts; is that right?

A. Yes, that is indicated by the flow-sheet here.

Q. 73. I notice in this diagram that the first vertical line that goes to the bottom, marked "table concentrates," has a little circle in it?

A. Yes.

Q. 74. Has that circle any significance?

A. The draftsman probably intended to put a numeral in it to indicate the number of products, the table concentrate probably being 1 or something like that.

Q. 75. Does this diagram illustrate the sources of the water supply for the mill; and if so, what does it indicate?

A. Yes. This diagram shows that fresh water for the operation was received from the mine; that water separated from the residual trailings was sent back and mixed with fresh water from the mine, in one or other of the tanks shown at the upper portion of the sheet; as shown, one tank may have been used for circuit water and the other for fresh water.

Q. 76. They are storage tanks, I take it?

A. They are storage tanks.

Q. 77. And as shown, the feeds could be combined or not; is that right? Or does it show them combined?

A. Yes, sir; in one tank it shows they could receive both

fresh and circuit water, circuit water being the water separated from the residual tailings.

Q. 78-79. Now, up on top there is a square with the words "X-cake solution tank." What does that represent?

A. Just a tank which receives a solution of X-cake or in which X-cake was dissolved with water.

Q. 80. And what does the diagram show as to what happens to that X-cake solution?

A. The diagram shows that the X-cake solution was drawn off through the bottom of the tank and passed into the feed to the rougher flotation cells.

Q. 81. And what does the diagram show as to whether or not in any of the subsequent flotation operations any further amount of X-cake solution is added?

A. The diagram does not show that any more was added in subsequent operations.

Q. 82. I think you will remember that the stipulation describes the addition of the X-cake. I will read it:

> "A solution of alpha-naphthylamin (X-cake) in water was introduced directly into the upper flotation rougher cells along with the overflow from the drag classifier."

In the absence of any other description, that shows that the X-cake solution was fed in at the commencement of the flotation operation, and no further amount was added; is that right?

A. Yes.

Q. 83. Now, Mr. Wilding, have you had anything to do with the construction and operation of a demonstration plant for the plaintiff, at Boston?

A. Yes.

Q. 84. And what have you had to do with it?

A. It was erected under my supervision, and I have, since the receipt of some ore from the Magma Copper Company, made a trial of results in the plant on that ore.

Q. 85. Generally, what kind of flotation apparatus or machines have you installed and used in that demonstration plant.

A. I have installed small Callow cells.

MR. WILLIAMS: It is stipulated that the two drawings which I now point to, on pages 16 and 17 of a pamphlet entitled "The General Engineering Company, Inc., Consulting Metallurgical Engineers" are publications of the company of Mr. John M. Callow, the patentee of the Callow cell.

Now I offer just these two drawings, or the picture and drawing in evidence as Plaintiff's Exhibit 8, being picture of five-ton Callow pneumatic flotation set, and Plaintiff's Exhibit 9, being drawings of five-ton pneumatic flotation set.

MR. DAVIS: May I know what the point is—what the purpose is?

MR. WILLIAMS: The purpose of the introduction of these into evidence is to identify them with the apparatus that has been installed at the plaintiff's demonstration plant; and we will show that the rougher cells shown in these drawings and in this picture are the rougher cells we received and changed over by putting in glass sides so as to be a demonstration apparatus.

MR. DAVIS: I have no objection to their going in for that purpose, your Honor; but I am assuming in saying that that they will connect them with what the defendant has done.

THE COURT: I assume that too.

(Received in evidence and marked "Plaintiff's Ex. No. 8," being picture of 5-ton Callow pneumatic flotation set; and "Plaintiff's Ex. No. 9," being drawings of 5-ton Callow pneumatic flotation set.)

Q. 86. Now this book which I have just produced and had the pictures and the drawings from it marked in evidence, when and under what circumstances did you first see that particular book?

A. The cells were purchased by a firm of importers and exporters in New York and were afterwards——

MR. DAVIS: Your Honor, I object; that certainly is not an answer to the question.

THE COURT: No, it does not appear to be. The ques-

tion is when and under what circumstances he got this book.

MR. GARRISON: When and under what circumstances he first saw the book.

A. (Continuing) This book came out of a box containing one of these small cells which I had installed in Boston.

MR. DAVIS: I object again, your Honor; that does not seem to me to be an answer to the question.

THE COURT: I think that answers the question. He asked how he first came across the book,

MR. DAVIS: May I have it appear that he took it out of the box?—if that is what he meant to say.

By THE COURT:

Q. 87. I presume you saw it in the box and took it out; is that so?

A. I took it out of the box.

By MR. WILLIAMS:

Q. 88. And this box contained how much of the apparatus shown in the two exhibits, the picture and drawings Plaintiff's Exhibits 8 and 9?

A. It contained the larger of the two cells shown in Plaintiff's Exhibits 8 and 9.

Q. 89. And that larger of the two cells is in that apparatus describable as what kind of a cell?

A. As the rougher cell of the set of two.

Q. 90. As a matter of fact, was there also a box, containing another of these rougher cells?

A. Yes.

Q. 91. And with that was there a similiar book?

A. Yes.

MR. WILLIAMS: I will ask the defendant to stipulate that these pieces of apparatus were obtained from the General Engineering Company, Mr. Callow's company.

MR. DAVIS: Can you go on and let that go for a moment, so we can check up on it? I would like to admit it, if it is so.

MR. WILLIAMS: Yes.

Q. 92. In the first place, what happened to these rougher cells of the Callow 5-ton pneumatic flotation set which were opened by you or in your presence?

A. The upper portion, consisting of the sheet iron walls and concentrate launders of these cells, was removed, and for that portion a frame of angle iron, with glass panels for walls was substituted.

Q. 93. How about the original dimensions, were they preserved?

A. Yes.

Q. 94. And how much of the material was changed to glass?

A. Just the walls.

Q. 95. That is the side walls and the end walls?

A. The side walls and end walls were changed to glass. The construction of the launders was changed also.

Q. 96. How about the baffle or partition of the feed compartment?

A. That also is a glass plate.

THE COURT: Is this the apparatus you intend to show me in Boston?

MR. WILLIAMS: Yes, your Honor.

THE COURT: Do you intend to take any testimony there concerning it?

MR. WILLIAMS: Probably not.

THE COURT: Describe it here and let it go at that?

MR. WILLIAMS: Describe it here and make the record complete.

MR. DAVIS: Mr. Willams, I rather thought Mr. Callow might know, but he says he knows nothing about it, and not having seen it, I cannot stipulate it.

Q. 97. When these boxes were opened, containing these two Callow 5-ton pneumatic rougher cells, did you do anything as to an examination of them for plates, indicating the name of the manufacturer?

A. Yes.

Q. 98. Have you the plates that were on these cells?

A. You hold them in your hand.

Q. 99. Were they removed by you or in your presence?

A. Yes.

MR. WILLIAMS: I offer these two plates in evidence.

MR. GARRISON: Put in the record what the legend is on them.

MR. WILLIAMS: Plaintiff's Exhibits 10 and 11, and I read the legend, which is the same on each plate:

"General Engineering Co., Metallurgical Engineers, Salt Lake City, Utah, U. S. A."

(Received in evidence and marked Plaintiff's Ex. Nos. 10 and 11.")

Q. 100. Now, Mr. Wilding, have you had drawings made, showing these pneumatic cells as they were altered, by putting in parts of plate glass, and with the modification of the concentrates launder and as installed in the plaintiff's Boston demonstration plant?

A. Yes.

Q. 101. What are the two sheets of drawings which I now show you?

A. One of them shows a longitudinal vertical section and a vertical cross-section of the cell. Another shows the feed end elevation and the side elevation of the cell.

MR. WILLIAMS: The two drawings are offered in evidence as Plaintiff's Exhibits Nos. 12 and 13, with the entitlement appearing upon them; the first: "Sectional views of pneumatic cell, Plaintiff's Boston Demonstration Plant;" and, second: "Elevations of pneumatic cell, Plaintiff's Boston Demonstration Plant."

(Received in evidence and respectively marked "Plaintiff's Ex. No. 12" and "Plaintiff's Ex. No. 13.")

Q. 102. Have you also had drawings made showing the entire plant as installed in Boston for the treatment of the ore received from the defendant?

A. The entire plant of grinding apparatus and Callow cell.

Q. 103. And the grinding apparatus includes what?

A. The Hardinge mill and the Dorr classifier.

Q. 104. And what kind of a mill is the Hardinge mill, generally?

A. It is known as the conical mill; consists of a short cylinder with cone ends, in which are a number of balls, which crush the ore that is fed through one of the trunnions into the mill.

Q. 105. Would you describe it generally as a ball mill?

A. It is a ball mill.

Q. 106. What is the drawing I now show you?

A. This is a plan showing the ball mill, the classifier and two pneumatic cells, two Callow cells.

Q. 107. And what two Callow cells are they?

A. They are two Callow cells of which I have given evidence.

MR. WILLIAMS: The drawing is offered in evidence as Plaintiff's Exhibit No. 14, with the entitlement appearing upon it, "Plan of ball grinding mill classifier and two pneumatic cells, Plaintiff's Boston Demonstration Plant."

(Received in evidence and marked "Plaintiff's Ex. No. 14.")

Q. 108. Now, Mr. Wilding, will you take the general drawing, the plan of Ball Grinding Mill, Classifier and two Pneumatic Cells, and describe what is there shown, naming the reference letters that appear upon the drawing?

A. The receptacle lettered A is a box in which the ore is received. B is a scoop that is attached to the mill and revolves therewith, which scoops up the ore in the box A and passes it into the mill C. It passes out—the ore-pulp which has been ground in the mill C—passes out of the other end of the mill into a short launder or trough F; whence it flows into another short launder G, which carries it to the classifier K. This classifier consists of a long narrow tank or trough which is closed at one end and open at the other, and set at an inclination to the horizon, in which there is a reciprocating frame with rakes attached to it. The oversized portions of the ore-pulp settle out in the portion of the classifier that receives the ore-pulp and are raked up an incline and discharged into the box A through a short connecting launder E. They pass with the newly added ore into the mill and

are re-ground. The portion of the ore that is already fine enough to be subjected to flotation, overflows at the other end of this classifier tank.

Q. 109. The right-hand end?

A. The right-hand end of this classifier tank, with most of the water that accompanied the solids into the classifier. The ore-pulp passes down the launder L into a junction box M.

Q. 110. M?

A. M. From which it passes through the launder N, which may be switched from one cell to the other of these two cells.

Q. 111. And how does it pass from the junction box M to the launder N?

A. It passes through a short pipe at the bottom of the box.

Q. 112. Which extends from the bottom of the box down to the launder; is that right?

A. Yes.

Q. 113. Now, take the sectional views of the pneumatic cell, and also the elevations of the pneumatic cell, and describe the apparatus shown, giving the reference letters?

A. Take the longitudinal vertical section. The plate marked O^1 is glass and divides off the feed compartment of the cell from the rest of the cell. Q is the inclined bottom of cell. P, P^1, P^2 and P^3 are the compartments under the canvas bottom of the cell into which air is blown. The air enters these compartments at the points shown by circles thereon.

Q. 114. And were the air pipes omitted from the drawings, for the purpose of clearness of illustration?

A. Yes. At the deep end of the cell is the tailings pocket R and the cone valve S, which is connected by means of a long rod to the lever which is attached to the float S^1. O is the overflow edge of the cell. That is to say the horizontal edge of the side over which the concentrates pass. T is a launder which receives these concentrates.

Q. 115. And is there a duplication of that launder at each long side of the cell?

A. Yes.

Q. 116. Now, describe that launder, referring to the side elevation more particularly?

A. The launder T is divided into four portions which have inclined bottoms. At the deepest portion of each of these parts of the launder is a thimble, to which is attached a pipe U, U^1, U^2 and U^3, which connects the launder with a pipe V. This pipe V is inclined to the horizon, and concentrates pass down it and are received at the lower end of the pipe.

Q. 117. What are the general dimensions of this Callow pneumatic cell?

A. The width of the cell is 12-¼ inches; the horizontal length is 57-½ inches; the depth of the shallow end is 25-½ inches and at the deep end is 37-¾ inches.

Q. 118. Now, are those inside dimensions?

A. They are inside dimensions.

Q. 119. Will you state them in feet and inches; or let me do it and check me up.

A. Well, I could state them in feet and decimals of feet; how is that?

Q. 120. No; feet and inches, please. Let me do it and check me up.

A. All right.

Q. 121. Four feet nine inches long.

A. Four feet nine and one-half inches.

Q. 122. Two feet one inch deep at the shallow end?

A. Two feet one and a half.

Q. 123. Three feet one and three-quarter inches deep at the deep end?

A. Right.

Q. 124. I did not get your width dimension in inches.

A. Twelve and one quarter.

Q. 125. That is one foot and a quarter of an inch?

A. Yes.

Q. 126. What appliances have you at the plaintiff's demonstration plant which you used in connection with this cell for the purpose of supplying the air that flows into the bottom of the cell?

A. I had a Roots No. ¼ blower for each cell.

Q. 127. How is that blower operated, and what does it deliver, expressed in the usual terms?

A. These blowers are driven from a line shaft which is driven by an electric motor. They deliver about 36-½ cubic feet of air per minute at 266 r. p. m.

Q. 128. Have you taken the blower statistics as they appear in the stipulation and reduced them to the necessary variation for the smaller-sized cells?

A. Yes.

Q. 129. And have you reproduced in these smaller-sized cells what you regard as a proper reproduction of what was done in the largest cells?

THE COURT: Proper or correct?

MR. WILLIAMS: Correct.

MR. DAVIS: I object to that. I think we ought to have the figures, and let it go at that.

THE COURT: I think that is harmless. The witness says he believes it to be correct?

THE WITNESS: Yes.

Q. 130. You have testified that you received ore from the defendant. Have you used that ore in these cells in carrying on operations?

A. Yes.

MR. WILLIAMS: It is stipulated that the ore that was received from the defendant——

MR. SAGE: Was shipped, Mr. Williams. We do not know what was received.

MR. WILLIAMS: It is stipulated that the ore that was shipped by the defendant to plaintiff's order was run-of-mine ore of the defendant's mine.

Q. 131. How did you receive this ore?

A. The ore came in a car load, in a railroad car; it was all in sacks. Each sack had a tag label, which was signed by Mr. Watson of the Magma Copper Company.

Q. 132. And was there a bill of lading with it?

A. There was.

Q. 133. And how do you know that the ore that you have

at the plaintiff's demonstration plant is the ore that came on these freight cars, or on a freight car, to Boston?

A. I saw it taken out of it.

MR. DAVIS: We won't make any point about that if he got the sacks.

MR. WILLIAMS: Then it is stipulated that the ore received was defendant's run-of-mine ore.

Q. 134. Now, with this ore did you receive any other specimens?

A. Yes; in the freight car with the ore came a barrel of lime and a can of X-cake.

MR. WILLIAMS: Will you stipulate that they were the defendant's lime and the defendant's X-cake, Mr. Davis?

MR. DAVIS: Yes, sir.

Q. 135. What was the condition of this ore of the defendant's, as to the grinding, when you received it?

A. It was somewhat coarse. There were a number of large sized pieces in it, pieces that in one dimension were three and perhaps even four inches at times—slabby pieces.

Q. 136. It was described as what—¾-inch?

A. I do not know how it was described; I think it was supposed to have been crushed to pass though a one-inch hole. There are pieces in it that would not pass a one-inch hole.

Q. 137. What further crushing did you submit it to?

A. I had to feed it directly into the ball mill. It was there crushed.

Q. 138. And that is the ball mill you have described?

A. Yes.

Q. 139. Now in using this ore and putting it through this mill, to what condition did you crush it?

A. I tried to crush or grind it to pass a 60-mesh sieve; some remained on the 60-mesh sieve—some of the ground ore I had to use in the flotation cells remained on the 60-mesh sieve.

Q. 140. What was the action of the classifier that you had operating in conjunction with the grinding mill?

A. That acted to separate the ore already ground fine enough for flotation from that which was not sufficiently ground.

Q. 141. Did you succeed in getting a feed to flotation of minus 60-mesh?

A. No, I have said that some did not pass the 60-mesh, but it was not a very large proportion.

Q. 142. Now if any of it was coarser than 60-mesh, was that against your operation or in favor of it?

A. Against it.

Q. 143. When you operated this mill with defendant's ore, did you put in any lime, and if so, where did you put it in?

A. Yes. Lime was added at the feed of the ball mill.

Q. 144. That is, in the feed box A, or in the scoop?

A. It was thrown into the scoop as the scoop came around.

Q. 145. And in what proportion did you add the lime?

A. About 1/100 of a pound of lime to ten pounds of ore.

Q. 146. What was the method of feed of the ore into the trough from which it was scooped up into the ball mill?

A. It was fed into that box by hand. The man feeding the ore used a small scoop shovel, which we had calibrated, so that each shovel full was approximately ten pounds of ore.

Q. 147. And what was the time arrangement under which he acted?

A. He threw in one shovel full a minute.

Q. 148. Now what else did you add in the process, besides ore, water and lime?

A. I added a solution of X-cake——

Q. 149. And what X-cake?

A. The defendant's X-cake—which was one part of X-cake contained in 1000 parts of water.

Q. 150. Where did you add that?

A. I added that at the launder, or rather, the junction box which is shown on Plaintiff's Exhibit No. 14, the junction box M.

Q. 151. In what proportion did you add that X-cake solution?

A. In the proportion which gave .48 of a pound of X-cake to a ton of ore.

Q. 152. Now, comparing what you did with what the defendant did in its mill, as described in the stipulation, and the annexed drawings, and the annexed reports, did you or did you not reproduce on a small scale the operations described in that stipulation?

MR. DAVIS: I object to that.

THE COURT: Well, suppose he will say he attempted to. Leave the result for settlement by argument and the Court.

MR. DAVIS: It leaves me, if your Honor please, to cross-examination in that sort of thing to bring out just what he did do. Of course I can do that, but it seems to me Mr. Williams ought to do it.

MR. WILLIAMS: I think I have pretty well.

THE COURT: I supposed he was attempting to do that. As far as I can see, he has covered the ground. Of course I am not familiar enough with it to know.

MR. DAVIS: All right.

THE COURT: He has described what he has done, and he said he attempted to reproduce the defendant's plant. I think we had better let it stand that way.

MR. WILLIAMS: Will you take the answer?

THE COURT: I will permit him to say that he attempted to.

A. I attempted to reproduce in the flotation operations the same conditions of operation that obtained in the defendant's mill. We were handicapped by the fact that we were unable to remove any portion of the sulphide minerals on tables before the ore pulp flows to flotation. With that difference in view, and perhaps with a difference that the grinding is not so good as it was at the defendant's mill, the conditions I think were very much the same under which I operated as those in the defendant's mill.

Q. 153. Comparing the blue print which has been marked Plaintiff's Exhibit No. 7, showing Callow pneumatic flotation apparatus as installed in the defendant's mill at the time referred to in the stipulation, and the pneumatic flotation cells which you used in the plaintiff's demonstration plant, what would you say as to their resemblances or differences?

A. They were similar, with the difference in dimensions.

Q. 154. And generally what is the difference in dimensions? Take the length of four feet nine and one-half inches of your smaller cells at the plaintiff's plant, what is the length of Callow cells as shown in that blue print?

A. The inside length of the Callow cells shown on the blue print is nine feet, one inch, which includes the feed compartment.

Q. 155. Did your dimension of four feet nine and one-half inches include the feed compartment?

A. Yes.

Q. 156. What is your opinion as to whether or not the same kind of operation was carried on in your smaller pneumatic cells, as was carried on in the defendant's larger pneumatic cells at its plant?

MR. DAVIS: I object to that.

THE COURT: Well, it depends on the theory with which we want to carry that on. I suppose we could leave it to cross-examination and bring out any statement that it is the same.

MR. DAVIS: He said that he tried to reproduce those conditions, and he has been limited to that, and I do not think he ought to be permitted to go beyond it.

THE COURT: I thought that was the better theory to go on. Let him describe what he did, that his purpose was to reproduce the conditions.

MR. WILLIAMS: Now, I am really on a further branch of the subject, to wit: whether or not the reproduction of the conditions involved the production in the cells of similar operations. I presume it is included in the other.

THE COURT: I think you had better leave it to description of both processes. If you will let him say he attempted to duplicate it, and describe the one he produced, and describe the one they were trying to produce, I think that would be better.

MR. WILLIAMS: He has already described the operation of the Callow pneumatic cells, so I will proceed to a description of what took place and what he did.

THE COURT: Yes.

Q. 157. When you fed to these pneumatic cells at the Boston Demonstration Plant the water, defendant's ore, the lime and X-cake, in the manner you have described, and supplied air in the manner you have described, what occurred in the pneumatic cells?

A. The ore pulp was set into agitation; a froth formed on the surface of the pulp, which was mineral bearing, and which overflowed the upper edges of the side walls of the cell into the launders placed to receive it. The tailings of the operation passed out of the cell through the tailings orifice or outlet shown on Plaintiff's Exhibit No. 12.

Q. 158. How much of the agitation that you have described was visible by reason of the glass walls of the cell with the ore-pulp in the cell?

A. One cannot see very far into the cell. The ore-pulp was opaque, but one could see through the glass walls that the ore-pulp was in agitation. On putting one's hand down into the pulp below the froth, one could feel the currents in the upper portion of the cell.

Q. 159. Did you carry on any operations in which the ore was absent in either of these cells?

A. Yes.

Q. 160. What did you do?

A. I passed into the cell the same amount of water and X-cake that I used in the other cell when the ore was present; also the same amount of air was driven into the cell.

Q. 161. What happened?

A. One could see in that case that the water was in a state of agitation, that the air that was blown in through the canvas bottom was broken up into fine bubbles by the presence of the frothing agent. I have omitted to say that I also added the same amount of lime.

THE COURT: The same amount as what?

THE WITNESS: The same amount as in the operation wherein the ore was present.

Q. 162. That is to say, you reproduced everything the same, except that you left out the ore; is that right?

A. That is right.

Q. 163. Now, will you take up the description?

A. There is a current flowing down along or close to the bottom of the cell. At the shallow end there is a rising current. Then there is a horizontal upper current flowing towards the tailings end, and a descending current in the tailings end region. These currents, these general currents are fairly constant. There are, however, numerous—what one might call —overlaid currents, irregularities and small vortices occuring in different parts of the cell. These are not constant in position. They change. They change rather rapidly, but the effect is such as must produce a very good mixing action.

Q. 164. You spoke in your description of descending currents at the deep end of the cell. What was the relation of those descending currents in speed to the speed of out-flow at the bottom of the deep end of the cell?

A. The speed of out-flow?

Q. 165. That is, did those currents go right down through the out-flow and out of the cell?

A. No; oh, no. It was a circulation.

Q. 166. And the down current at the deep end of the cell merged into what?

A. Merged in the lower current, and a portion of it passed out of the tailings valve, a portion of the water.

Q. 167. Now, returning to the operation in which you had the ore present, are you able to form a judgment, as the result of your experience in the air-froth flotation process, as to the general character of the concentrate which overflows from a flotation operation?

A. The concentrate appeared of fair grade.

Q. 168. You have not answered the question: Are you first able to form a judgment as a result of your experience—please state.

A. Yes.

Q. 169. Now, what was your judgment of this concentrate which overflowed when you carried on these operations?

A. The concentrate appears to me to be of fair grade. I did not see much gangue in it.

Q. 170. Now, taking into account all the difficulties that you labored under, would you regard that as a fair concentration which you obtained?

A. Yes.

Q. 171. Now, generally, as to the operation described in the stipulation, and which you attempted to reproduce as nearly as possible in the plaintiff's demonstration plant, did you mix powdered ore with water containing in solution a small quantity of the mineral-frothing agent?

Mr. Davis: Your Honor, I object to this. I think that the witness has fully described what he did. The only purpose of questions of this character is to take the claims of the patent and read them over and have the witness put his own interpretation on the claims and then answer. Of course, it is for the Court to interpret the claims.

Mr. Williams: Of course, the witness is a metallurgist skilled in the art, and claims are addressed to a metallurgist skilled in the art, and the Court would probably like to know the meanings of the claims to a metallurgist skilled in the art: and what I have started to read to the witness is a part of a claim, Claim 1 of the patent in suit.

The Court: That is what I supposed.

Mr. Williams: Of course, your Honor will construe the patent. I thought you would like to know what those words meant to a metallurgist skilled in the art and particularly skilled in this process.

The Court: It seems to me to be more logical to ask him what he mixed with the ore and water, instead of saying he mixed a small quantity of mineral-frothing agents.

Mr. Williams: All right, I will put it in that form.

Q. 172. In the operation of the defendant, as defined in the stipulation and in your operations as described by you, at plaintiff's demonstration plant, did you use powdered ore?

A. Yes.

Q. 173. What did you mix with that powdered ore? Of course, you have testified you mixed lime and alphanaphthylamin or X-cake?

THE COURT: This X-cake was intended to be a mineral-frothing agent, I understand.

MR. WILLIAMS: Yes, sir, so I assume.

Q. 174. State what you know in regard to X-cake, as to whether or not it is a mineral-frothing agent?

A. It is.

Q. 175. Is X-cake an organic substance?

A. It is.

Q. 176. You have testified that there was agitation of the mixture. What was the result of agitation of the mixture?

A. The result was the formation of a mineral-bearing froth.

Q. 177. And was there a separation of that froth?

A. There was.

Q. 178. And how was it separated?

A. It overflowed the upper edges of the side walls of the cell.

Q. 179. And what did it carry as it overflowed; what did the overflow carry as it overflowed?

A. It carried the mineral.

Q. 180. And consisted of what?

A. It consisted of water, air and sulphide minerals and other minerals.

Q. 181. Now, you have testified that for the past ten years you have been carrying on the process of air-froth flotation. What process was carried out in defendant's mill and by these operations that you have described in plaintiff's demonstration plant?

MR. DAVIS: I object to that.

THE COURT: Do you want him to describe it?

MR. WILLIAMS: Name it.

THE COURT: Name it.

MR. WILLIAMS: Identify, if you will, what he has been doing for the past ten years.

THE COURT: Yes, I think you may do that.

MR. DAVIS: Exception.

By THE COURT:

Q. 182. What do you call it?

A. The air-froth flotation process of ore-concentration.

Q. 183. You said this X-cake was an organic substance, did you?

A. Yes, sir.

MR. DAVIS: The most I can do about that shipping paper—what do you call it, invoice?

MR. WILLIAMS: Manifest.

MR. DAVIS: Manifest—Mr. Callow says that that is undoubtedly the ordinary manifest issued by his company. He has no recollection at all, knows nothing about that particular shipment. We are willing to stipulate that this is written on a manifest sheet of the company.

MR. WILLIAMS: Just one small matter. I have talked with Mr. Davis about stipulating the manifest and packing list which came with the two Callow cells which we changed over into glass-sided cells.

By MR. WILLIAMS:

Q. 184. What is the document which I now hand you, Mr. Wilding?

A. This a packing list which gives the articles which came in each of the four boxes of the shipment.

Q. 185. The shipment that you have testified of?

A. The shipment of which I have testified as consisting of two boxes containing rougher cells, and two boxes containing cleaner cells.

Q. 186. How did you come to receive or have that shipping list?

A. I received this list from Roces & Company of New York.

Q. 187. Was it in connection with these boxes containing this material that you received this shipment or manifest list?

A. Yes.

MR. WILLIAMS: Now, I understand that the defend-

ant will stipulate that this is the ordinary manifest and packing list of Mr. Callow's company, the General Engineering Company.

MR. NEARY: Form, not list.

THE COURT: On that kind of a blank. I understood him to say on that kind of a blank.

MR. GARRISON: Yes, this is their usual blank.

MR. WILLIAMS: I offer in evidence as Plaintiff's Exhibit No. 15, manifest and packing list Callow cells.

(Received in evidence and marked "Plaintiff's Ex. No. 15.")

MR. WILLIAMS: Now, I am through with the direct examination, Mr. Davis.

MR. DAVIS: I think if we might adjourn for luncheon now, I can look over these exhibits.

THE COURT: All right, then. We will suspend until two o'clock.

(Recess taken until 2 o'clock p. m.)

AFTER RECESS.

CROSS-EXAMINATION.

By MR. DAVIS:

XQ. 188. In describing the operation according to the stipulation, Mr. Wilding, you mentioned the putting in of water to an amount about equal to the weight of the ore in the first ball mill. You remember that?

A. I stated that I did not think it would exceed that amount.

XQ. 189. And subsequently more water was added, so that when the pulp went into the flotation cells, there was something over four times as much water as solids?

A. That is so.

XQ. 190. It is true, is it not, that all of this mill apparatus which comes before the flotation cells is standard appara-

tus, appropriate to be used in a mill where you have gravity separation alone?

A. Yes.

XQ. 191. That is, if you were not using a flotation system, but only, for example, these Wilfley tables, you would have the same sort of apparatus, and it would operate the same way?

A. Yes.

XQ. 192. The flotation process begins at the Callow cell in the defendant's plant?

A. Yes.

XQ. 193. What was the date of your first experience in flotation?

A. Do you mean when I first knew of it, or saw it, or was engaged in work connected with it, or what?

XQ. 194. Well, when you first had any metallurgical knowledge so that as a metallurgist you could say what the process or processes of ore-concentration by flotation were

A. Perhaps in 1907 I came across the flotation process. It was, though, 1913, before I did any work in the process.

XQ. 195. And as I take it, you mean that you came across it in the literature and such reading as you do as a metallurgist, but you had no practical experience until 1913 is that it?

A. Yes.

XQ. 196. You said this morning that you had had practical experience in 1913 with the air-froth flotation process of ore-concentration. Had you had experience with more than one, or only one air-froth flotation process?

A. Well, I have had experience of one process, carried out in different ways.

XQ. 197. Had you had experience with the agitation froth process of the Minerals Separation Company in 1913

A. Previous to that time, do you mean?

XQ. 198. Previous to that time or in that year?

A. Previous to that time I had seen it in operation. In that year I myself was engaged in laboratory work with the process.

XQ. 199. Where had you seen it in operation?

A. In South Wales.

XQ. 200. And that process was carried out, was it, with a Gabbett agitating machine, and then the agitated pulp was flowed into spitzkasten?

A. No.

XQ. 201. How was it carried out?

A. There was no Gabbett mixer. The agitation boxes contained an impeller or agitator that took the form of a cross.

XQ. 202. Was it a Minerals Separation machine?

A. Yes.

XQ. 203. The so-called close-coupled machine of the Hoover patent?

A. Really I never heard of that term "close-coupled machine of the Hoover patent."

XQ. 204. You do not know what I mean when I say the close-coupled machine?

A. No, I do not.

XQ. 205. Well, go ahead and describe it, please?

A. As I recollect that machine there were three agitation boxes through which the ore-pulp flowed. From the third box it passed into a spitz.

XQ. 206. Was it just such a machine as is illustrated in the drawings of the patent in suit?

A. It is something like that, only it was differently arranged.

XQ. 207. To what extent?

A. The froth came out of the third agitation box into a spitz.

XQ. 208. What do you mean by "the froth came out?"

A. Pardon me. The ore-pulp passed out at the bottom of that spitz and the froth overflowed the lip of the spitz which, however, relative to this box, was in a different position.

XQ. 209. It was on the side instead of the end?

A. Yes.

XQ. 210. That was a standard Minerals Separation machine?

A. It was not exactly what we call the standard machine at the present date. From the first spitz the tailings were lifted by a little air-lift into another agitation box, passed through that one and another agitation box before entering the second spitz, and there were in all, I think, seven agitation boxes and three spitzes.

XQ. 211. Is this at the plant in South Wales that you are talking about now?

A. That was at the plant in South Wales. I did not have anything to do with the running of the plant, but I saw it in operation.

XQ. 212. And in the operations there, was there a small quantity of a mineral-frothing agent, an organic mineral-frothing agent, added to the pulp?

A. Yes.

XQ. 213. What was that agent?

A. The agent was oleic acid.

XQ. 214. Do you know in what quantity it was used?

A. No.

XQ. 215. And then the pulp containing the small quantity of organic mineral-frothing agent was agitated in these agitation boxes, was it?

A. Yes, sir.

XQ. 216. Quite violently?

A. No, I do not think one would call it "quite violently."

XQ. 217. Do you know what the speed of rotation or revolution of the propellers was?

A. No, I do not recall that.

XQ. 218. Do you know what amount of energy was expended in impelling it?

A. No, I do not know.

XQ. 219. And then after agitation the pulp was run into the spitzkasten?

A. Yes.

XQ. 220. And there came substantially to rest?

A. Yes, sir; the pulp in the spitzkasten is rather quiescent.

XQ. 221. And there rose to the surface a stiff, coherent, froth, containing the mineral?

A. There rose to the surface a froth containing mineral.

XQ. 222. Was that froth coherent?

A. Yes, sir; it was coherent.

XQ. 223. Did that froth rise immediately out of the body of the pulp, immediately?

A. It rose toward the back of the spitzkasten, as I recollect.

XQ. 224. But out of the body of the pulp?

A. Yes, as I recollect.

XQ. 225. But you were satisfied those things of which the froth was made up existed in the pulp body when it was in the agitating machine?

A. I would say they were in the ore pulp as it came from the agitating boxes—as it came from the agitating boxes into the spitz.

XQ. 226. Have you had any experience with any other air-froth flotation processes?

A. I have worked in mills in which the operations were carried out in the pneumatic cells.

XQ. 227. Have you ever had any experiences, or have you any knowledge, of any other air-froth flotation processes, that is, of any agitating froth processes other than the air flotation process and this pneumatic process?

A. I should say no.

XQ. 228. Did you ever hear of the Bessel process in which the gas bubbles were generated in the body of the pulp by the action of acid on a carbonate?

A. I do not think I know anything about that. I have seen the name. That is about all. Anything else about it I do not know.

XQ. 229. Did you know anything about the so-called Froment process in which a small quantity of oil was used with the generation of gas bubbles in the pulp by the action of acid on a carbonate?

A. I know very little about it. I never saw it in action at all.

XQ. 230. Never had any experience with that?

A. No.

XQ. 231. Never saw it in operation?

A. No.

XQ. 232. Do you know anything about the so-called Elmore vacuum process in which there was used a small quantity of oil or an organic mineral-frothing agent, and in which——

MR. WILLIAMS: If your Honor please——

THE COURT: Let him finish the question.

MR. WILLIAMS: I beg your pardon.

XQ. 232. (continued)—and in which the air particles were attached to the oiled mineral in the pulp by using a vacuum, so that the particles rose to the surface as a mineral-bearing froth?

MR. WILLIAMS: I object to the question, because it is plainly evident that the defendant's counsel is now putting to this witness the various things that he is going to rely upon for defenses, for the purpose of extracting from this witness such knowledge as he may have, if he has any, of the things that the defendant will rely upon for defenses, as not warranted by the direct examination as to which this matter has no bearing whatsoever, and cannot be shown to have any bearing at this stage of the case. The defendant is anticipating his defense in cross-examination of plaintiff's witness.

THE COURT: So far he has only asked the witness if he has heard of these processes which might go, on cross-examination, properly to or bear upon his capacity as an expert witness, reliability and so on. He has not attempted yet to produce through this witness any direct testimony of those processes.

MR. WILLIAMS: But he describes them in his questions.

THE COURT: He asked him if he knows of them—if he heard of them.

MR. WILLIAMS: Or knows of them, as I understood.

THE COURT: I do not think it is objectionable. I will let him answer.

THE WITNESS: Read the question, please.

(XQ. 232 was repeated as recorded.)

A. I do know about the Elmore vacuum process as conducted with a small quantity of fuel oil.

XQ. 233. Would you include that within the meaning of what you mean when you say an air-froth flotation process?

A. No, I do not think I would.

XQ. 234. Why not?

A. We did not use——

MR. WILLIAMS: Now, I object, your Honor. This witness is called upon to differentiate between something in the prior art not yet proved, and the thing of which he is testifying.

THE COURT: It is just a question where to draw the line. Your theory in principle, I think, is correct. He should not, through this witness on cross-examination, produce any substantive defense or anything of that kind. The most he can do is to inquire as to his experience and knowledge as an expert metallurgist and his knowledge of the thing in question.

MR. WILLIAMS: He is asking him to compare.

THE COURT: Counsel ought to be able to differentiate themselves, I think, without any instruction.

MR. DAVIS: I have no intention of developing my defenses by this witness. The witness has used the expression "air-froth flotation process," particularly at the end of his deposition, to identify the defendant's process with the plaintiff's. I want to know what he means and what he knows about it.

THE COURT: I think you can go into that to some extent, but I think you appreciate my position and recognize the rule.

A. (Continued to XQ. 234.)—We used in that method of flotation an agent which I have found in the method of flotation to which I have testified does not give a mineral-bearing froth.

XQ. 235. What do you mean by the flotation process to which you have testified?

A. The flotation process to which I have testified this forenoon.

XQ. 236. You mean the process in which you have agitation?

A. Yes.

XQ. 237. What was that agent?

A. It was a heavy fuel oil.

XQ. 238. Did you not ever know of the Elmore process being practiced with any other agent than that?

A. No.

XQ. 239. I am trying to get the meaning, if I can, Mr. Wilding, in your mind, of the words "an air-froth flotation process." As I understand it, this Elmore vacuum process produced a mineral-bearing froth made up of air bubbles, did it not?

A. I do not think I would call that a froth——

XQ. 240. Just answer the question, please, first. Did it or did it not?

A. No.

XQ. 241. Do you say that the froth in the Elmore process is not a mineral bearing froth made up of air bubbles; do you say that?

THE COURT: Do you understand the question?

THE WITNESS: Yes. I understand it.

A. No. In my opinion that is not a mineral-bearing froth as it passes over the constricted portion of the Elmore apparatus.

XQ. 242. Unless, Mr. Wilding, those words "constricted portion of the Elmore apparatus," have some restrictive significance, that I do not understand, I ask you to answer the question directly. Can you not answer it, leaving out those words, which the Court does not know anything about, so far as I know?

A. The discharge from the Elmore apparatus seems to me to consist more of independent floccules of mineral, borne up by air, than to be a froth.

THE COURT: What is a froth, from your point of view?

THE WITNESS: A froth is a mass of bubbles in contact, one with the other.

XQ. 243. Well, in the popular sense, Mr. Wilding, is not this froth of the Elmore process a frothy mass full of bubbles and mineralized heavily?

THE COURT: How do you differentiate, Mr. Wilding, between the result of that process he refers to and your view of the mineral-frothing process?

THE WITNESS: In the air-froth flotation process, the mineral appears to be at the walls of the bubbles of the froth, and I think that in the Elmore vacuum process the attachment of air is to oiled floccules of minerals.

Q. 243-a. In either case, it is true, is it not, that this preferential affinity of the agent for the mineral has come into play and has caused the adhesion of air bubbles to the mineral particles and the lifting of those particles to the surface, so that they can be removed as a concentrate?

MR. WILLIAMS: I object to this long theoretical statement. Defendant's counsel is injecting all sorts of theories into his questions, and it does not seem to be a fair cross-examination of a witness who has testified to some plain simple thing, having in mind that the cross-examination is to be limited to the subject of the direct and having particularly in mind, in a patent case, that the object of the defendant's counsel is to get as much as he can out of the *prima facie* testimony of the witnesses, and that the Courts have drawn the line very closely as to what shall be the subject of cross-examination of a witness for the plaintiff in the *prima facie* case.

THE COURT: The purpose of this examination is along those lines, as I understand it, and if I do so understand it, it is proper, that is, it is to develop what the witness means by certain terms he has used previously in direct examination to which this frothing process or mineral-frothing and what-not applies.

MR. GARRISON: Air-froth.

MR. WILLIAMS: "Air-froth flotation process" is the term the witness has used.

THE COURT: That is what I thought, and that is why I have admitted it. If it is confined to that it may be admissible.

MR. WILLIAMS: I object to the question itself as confused and indirect, and not a fair question based upon the evidence of this witness.

THE COURT: Possibly the question may be framed to be more lucid. I have no opinion on that.

MR. DAVIS: If the question is not plain to the witness, and if the witness does not understand it, I will reframe it. Please repeat the question.

(XQ. 243a. was repeated as recorded.)

MR. WILLIAMS: In that question are the words "this preferential affinity." There is no antecedent in any part of the testimony of this witness or any statement as to preferential affinity, and he is not entitled to say "this preferential affinity" in questioning this witness. It is a question that is misleading in form and tending to misrepresent the testimony of the witness.

THE COURT: The witness clearly is highly intelligent along these lines, and I do not think he is deceived. Of course, counsel should frame the question fairly predicated upon what is in the case or upon what the witness has previously said.

MR. WILLIAMS: I would like to note an exception with regard to that ruling.

THE COURT: The witness has said, as I understand it, that he does not regard the process he referred to as a fair exponent or expression of the air-frothing process. Is that true? Do I understand that correctly?

THE WITNESS: Yes, your Honor.

THE COURT: And you want to develop by cross-examination what that is based upon?

MR. DAVIS: Yes; how he distinguishes one from the other. What is the criterion?

THE COURT: If you think his answer is not correct, I think you can develop and show by him if he has made a mistake.

MR. GARRISON: We would not object to that question, but we object to a lot of assumptions of fact that this witness says he knows nothing about.

Q. 244. What is the criterion by which you differentiate this method from the agitation-froth method, so that you call the agitation method an air-froth flotation method and you do not call this one an air-froth flotation method?

A. In the case of the air-froth flotation method there is a distinct froth. In the Elmore Vacuum process I do not think there is a distinct froth.

By The Court:

XQ. 245. Is that the reason why you do not call it an air-froth process?

A. Yes, sir.

XQ. 246. That is how you distinguish from the air-froth process—the lack of froth?

A. Yes, sir; the matter of froth.

XQ. 247. The lack of froth?

A. Yes.

By Mr. Davis:

XQ. 248. And you do not base your distinction upon the fact that in the one case an organic mineral-frothing agent having a preferential affinity for metalliferous matter is used and not in the other; do you?

A. No.

XQ. 249. To go for a moment, Mr. Wilding, to this demonstration plant in Boston: you said, as I understand it, that you were trying to get the air conditions in the demonstration plant the same as the air conditions in the mill plant—was that right?

A. Yes.

XQ. 250. Now can you tell me briefly what you did to achieve that result?

A. Yes.

The Court: He said briefly, you know.

The Witness: There is a figure given in the stipulation for the amount of air supplied to the Callow cells in the mill. There is a figure given per unit of air-flotation area or horizontal area of the cell, as I understand it. That works out to a certain volume of air per

cell; the volume of cell being known, the volume of air per unit of volume of cell is also known, and with that ratio, and the dimensions of the small Callow cell in the demonstration plant known, I arrived at a figure of the air to be supplied to the small cell in the demonstration plant. That amounts to somewhere round 40 cubic feet per minute.

XQ. 251. 40 cubic feet of air per minute in the demonstration plant, you mean?

A. Yes sir, to be supplied to one single cell in the demonstration plant.

XQ. 252. That is, if I understand it, what you tried to do is have the volume of air per unit of volume of the little cell the same as the volume of air per unit of the volume of the big cell, is that right?

A. Yes.

XQ. 253. You spoke this morning about a circulatory current in the demonstration cell, and, if I recollect, about other similar variations of that current and vortices. Now, is that circulatory current a substantial one?

A. Yes.

XQ. 254. And it represented the major part of the movement of the pulp in the cell?

A. Yes.

XQ. 255. The other movements were, as you said, blanketed, I think, or at any rate they were slight variations of that major movement?

A. They were not so slight.

XQ. 256. Well, minor variations of the major movement of the stream?

A. Yes.

XQ. 257. Could you measure the velocity of the circulatory current?

A. No.

XQ. 258. So far as you know, the velocity of that current was not measured, was it?

A. It seems to me that it is a very difficult thing to measure it at all.

XQ. 259. That is not an answer, Mr. Wilding. Do you know whether it was measured or not?

A. In Boston, it has not been measured.

XQ. 260. If you look at this sectional view of pneumatic cell, Plaintiff's Boston Demonstration Plant, Exhibit No. 12, as I understand it the downward body of this circulatory current was in the region immediately above the tailings pocket marked R.

A. Well, not immediately above. It is not confined to such narrow limits.

XQ. 261. No, but it was at that end of the cell?

A. At that end, yes.

XQ. 262. And then it went up the incline at the bottom and rose at the intake end of the cell?

A. Yes.

XQ. 263. Is that the direction of the circulation?

A. That is the general direction of the circulation.

XQ. 264. In this cell there is a dead space—that is a space under which no air is admitted from the lower end of the blanket—that is from the end partition of the air-box P^3 to the lower end of the cell, is there not?

A. Yes.

XQ. 265. Did you ever compare the length of that dead space along the bottom of the cell, with the length of the corresponding dead space along the bottom of the Callow cell that was used at the defendant's plant, according to the stipulation?

A. No. Do you refer to a dead space that I may have seen in the Callow cell as used at the mill?

XQ. 266. No, I mean this, Mr. Wilding—I will ask a series of questions if you do not know what I mean. What is the linear dimension on this demonstration cell on the bottom of that dead space—that is, the linear dimension from the partition at the lower end of the box P^3 to the lower wall of the cell?

A. That is about nine inches.

XQ. 267. Now, what is the corresponding linear dimension beneath the dead space in the cell, used at the defendant's plant, according to the blue print?

A. There appears to be about five inches.

XQ. 268. That is in the big cell the length of that is five inches and the little cell nine inches?

A. Yes.

XQ. 269. And the total length of the big cell, the inside dimension, is about 8 feet 4 inches, is it not?

A. I have taken the inside dimension of this large cell at the mill, excluding the feed compartment, as about 8 feet 6 inches. There is no dimension given for it.

MR. DAVIS: I am not going to do any figuring with this witness. I want my witnesses to do it and to bring the point out.

MR. WILLIAMS: Mr. Wilding, just tell us the exhibit number of that blue print you have been referring to for identification.

THE WITNESS: Plaintiff's Exhibit No. 7.

XQ. 270. In this demonstration the pulp was alkaline throughout, on account of the ore condition, or rendered so by the addition of lime, was it not?

A. Yes.

XQ. 271. Did you assay the concentrate?

A. No.

XQ. 272. As far as you know, it was not assayed?

A. It was not assayed.

XQ. 273. You said this morning that one of your duties was to test oils?

A. No, I did not—ores.

XQ. 274. To test ores—did you ever test oils for these flotation processes—that is, select flotation agents?

A. Why, yes; I have used various flotation agents.

XQ. 275. How did you make such a test?

A. I have only made tests as to the applicability to each case.

XQ. 276. How did you proceed; that is, did you take a measured quantity of the oil?

A. I took a measured quantity of the oil and a weighed quantity of ore, a measured quantity of water, and put them into a small laboratory machine and agitated them with air.

XQ. 277. In such a case where you have an ore to float how did you determine what oils to experiment with?

A. I had when I was doing that work a very general rule of starting by using pine oil.

XQ. 278. Pine oil is an oil derived from pine, from the pine tree; isn't it?

A. Yes, sir.

XQ. 279. And it contains phenol and cresol?

A. Does it?

XQ. 280. Does it? I ask you.

A. I cannot say.

XQ. 281. You do not know what its constituents are?

A. No.

XQ. 282. Well, if the pine oil does not work, what do you do then?

A. I try other agents until I get a result.

XQ. 283. Other oils or oily substances?

A. Yes, I should call them that.

XQ. 284. That is, being a man skilled in the art, you know that generally oils and oily substances display this preferential affinity for mineral particles, don't you?

A. Yes.

XQ. 285. And you would keep on trying all the oils and oily substances that you knew of until you got one that did the work?

A. Yes.

XQ. 286. And would you restrict yourself by thinking of or adopting in your mind a restrictive meaning of oils and oily substances, or would you try anything that displayed the characteristics of oil, to see if it would work?

A. Well, I have not gone very wide afield in that department of flotation. I have found that with oil or oily substances I have been able to do what was necessary, and with comparatively few of them at that.

XQ. 287. Well, what would you think of banana oil as an oil or oily substance that would make a good flotation agent?

A. I do not know what banana oil is.

XQ. 288. Banana oil is amyl acetate.

A. Yes?

XQ. 289. Would you think of that as an oil or oily substance that would do the work?

A. No, I would not think of banana oil as an oil or oily substance that would do the work.

XQ. 290. You do not think banana oil is an oil or oily substance?

A. Really I know very little about banana oil.

XQ. 291. Do you know what fusel oil is?

A. Amyl alcohol, isn't it?

XQ. 292. Would you call that an oil or an oily substance?

A. No.

XQ. 293. Would you call pine oil an oil or an oily substance?

A. Yes, sir; I think pine oil is an oily substance.

XQ. 294. Would you call creosote an oil or an oily substance?

A. Yes.

XQ. 295. If you had been told that banana oil or amyl acetate did display preferential affinity for minerals, which is characteristic of oil and oily substances, would you reject it for that reason as a suitable thing to try?

MR. WILLIAMS: I object to the question, as indeed to most of the questions on this line, which have been objectionable. The witness is being cross-examined as a chemist in regard to the scientific properties or the chemical properties of certain substances, and he has qualified as a metallurgist, familiar with this art, and he has not said anything at all about this substance.

THE COURT: The questions have been put rather fully. He might as well answer this one. I presume it is about the end of that line of questions.

MR. WILLIAMS: May we note an exception to the ruling?

MR. DAVIS: Will you repeat the question?

(Question repeated.)

A. No.

XQ. 296. Can you explain briefly, Mr. Wilding, why it is that you think of banana oil as not an oil or an oily substance, and you think of pine oil as an oil or an oily substance?

MR. WILLIAMS: I make the same objection.

THE COURT: That is to say, you mean——

MR. WILLIAMS: He is not a chemist. He is not produced as a chemical expert. He has not testfied as to this subject matter. He is being cross-examined as to several things, one of which he testified he did not use.

THE COURT: He has been produced as an expert on these general lines.

MR. WILLIAMS: As a metallurgist familiar with the air-froth flotation process.

MR. DAVIS: I am asking him what he would do as a metallurgist.

THE COURT: Doesn't that involve the function or use of certain oils on metals and ores in connection with these matters?

MR. WILLIAMS: I think as a practical metallurgist. He is introduced as a practical metallurgist and not as a chemist, or as a scientific expert, or a physical chemist or anything of that sort. The cross-examination is going into the domain of the scientific qualities of these different substances that have been interjected into the case on cross-examination.

MR. DAVIS: I do not intend to do that. I want to know what he, as a metallurgist, would do with these oils, and he says in answer to certain questions that he did not think that banana oil was an oil or an oily substance, just as he had said that in the Elmore Vacuum process he did not think this Elmore Vacuum was a froth-flotation process. I want to know what his testimony means.

THE COURT: I understand he has been produced as an expert metallurgist—at least he claims to be familiar with these processes, and with machines calculated to produce certain results. I am not an expert sufficient to know where to draw this line. He may be a metallurgist who is expert in these things and unfamiliar in other lines not connected with them.

MR. WILLIAMS: Well, if your Honor please, there is a domain of theoretical chemistry and theoretical physics which is now being invaded. The metallurgist takes these materials and uses them. There has never been any evidence that this witness ever took this banana oil and used it, this oil as to which he is now being asked. He is asked to define its characteristics and explain its qualities. The metallurgist takes these things and uses them and sees the results; and that is the domain that this witness has testified about.

THE COURT: He was not asked to define the qualities of banana oil. He was asked if he knew what they were, and he said he did not know what amyl aceate was.

MR. WILLIAMS: And he is asked how it would act.

MR. GARRISON: He is asked why if he called one thing an oil he called another thing an oil.

XQ. 297 (Repeated): "Can you explain briefly, Mr. Wilding, why it is that you think of banana oil as not an oil or oily substance, and yet you think of pine oil as an oil or oily substance?"

THE COURT: It is examining the mind of the witness with relation to his previous statement, in a general way.

BY THE COURT:

XQ. 298: Why is it?

A. Pine oil, to me, has an oily appearance and an oily feel, to some extent. My recollection of amyl acetate goes back a long way. I have not come in contact with it in recent years, but it is not my recollection that it has an oily appearance and feel.

MR. DAVIS: If your Honor please, I asked the witness to explain about his work in testing oils, and I have got that. I so understood it, and the record has it that way.

MR. WILLIAMS: "Ores."

THE COURT: He did not say "oils," he said "ores."

BY MR. DAVIS:

XQ. 299: You said you had some experience with the pneumatic flotation process?

A. Yes.

XQ. 300: What did you say about that?

A. I said I had worked alongside of it in several places.

XQ. 301. Now, as the pulp is flowed into a pneumatic cell it does not contain any froth then, does it?

A. Sometimes it does.

XQ. 302. I mean, it is not like a pulp that has been agitated in an agitation froth process, as it flows into the spitzkasten. That is, no body of froth will rise to the surface of the froth if you will let it flow into a pneumatic cell, will it?

A. Without any frothing agent?

XQ. 303. No, with the frothing agent.

A. It will form a froth then.

XQ. 304. I mean without any air.

A. Without any air—yes, very little.

XQ. 305. That is, if you use the pneumatic cell like a spitzkasten and just run the pulp into it, you won't get any froth without the air?

A. No; neither with the other will you get it without any air.

XQ. 306. When I say without any air, I mean with the air in the Callow cell turned off. Is that what you understood me to mean?

A. Yes.

XQ. 307. You so understood me?

A. Yes.

XQ. 308. Now then, when you turned the air on, this froth begins to foam on the surface and builds itself up until it overflows the lip, does it not?

A. Yes.

XQ. 309. About how deep is that, ordinarily; that is, the layer of froth?

A. In most places it may be said to be about 8 inches deep.

XQ. 310. Now, if you turn off the air, what happens?

A. The froth decreases in volume.

XQ. 311. Subsides?

A. Subsides; yes; air escapes from the froth.

XQ. 312. If you take some of the pulp body from a pneumatic cell during the process, that is, while the air was running through it, and took that portion of the pulp body and put it into a spitzkasten and brought it to rest there, would there be formed a body of froth on the top of it?

A. Yes, I think so. I have never tried it.

XQ. 313. Well—if you never tried it?

A. I have never tried it.

MR. GARRISON: He said he never tried it.

XQ. 314. The X-cake of course in this demonstration plant of yours was in solution?

A. Yes.

XQ. 315. How did you tell that?

A. I took part of the solution and filtered out everything which appeared to be solid matter from it; and the resulting filtrate still had a frothing effect. It was clear and bright and still had a frothing effect.

XQ. 316. And still contained X-cake, you mean?

A. I judge it still contained X-cake because of this frothing effect.

XQ. 317. In saying that the froth consisted of water, air, sulphide, and other mineral, you did not mean to imply it did not also contain the flotation agent X-cake, did you?

A. No. I suppose it would contain that in the quantity related to the water present.

MR. DAVIS: That is all.

RE-DIRECT EXAMINATION.

By MR. WILLIAMS:

RDQ. 318. As I understood you in cross-examination, Mr. Wilding, you said that the figure you had determined for the proper figure of the demonstration plant at Boston was 40 cubic feet per minute of air; is that right?

A. Somewhere about that, 40 or 41, I think.

RDQ. 319. What did you actually use in the tests in the operation described?

A. 36,—a little more, perhaps, than 36.

RDQ. 320. So you keep under the figure that you had determined; is that right?

A. Yes, sir.

RDQ. 321. What procedure did you adopt in plaintiff's Boston demonstration plant to put the defendant's X-cake in solution?

A. I put it in a tank in which I have a central air-lift pipe. I put 1,000 pounds of water in the tank and one pound of X-cake. By means of two heaters, with a circulating system, I heated the water to about 135 degrees F., and I blew a small stream of air into the water so as to keep the liquid in agitation, the circulation being upward through this air-lift pipe I have spoken about, and downwards outside.

RDQ. 322. Now, are you familiar with the figure that is usually given to the solubility of X-cake in the engineers' text books?

A. I have seen tables which gave solubility.

RDQ. 323. Well, take the "Chemiker-Kalender;" is that a recognized text book?

A. Yes.

RDQ. 324. For the use of engineers?

A. And for chemists, yes.

RDQ. 325. What is the figure that is given in the "Chemiker-Kalender," or can you give the figure from any book that you have, if you prefer to?

A. It is given in this book as .17 parts of alpha-naphthylamin in 100 parts of water as the degree of solubility of X-cake.

RDQ. 326. And what is that book called?

A. Hand book of chemistry and physics, by Charles D. Hodgman, M. Sc., Associate Professor of Physics at the Case School of Applied Science, and Norbert A. Lange, Ph. D., Assistant Professor of Organic Chemistry at the Case School of Applied Science.

RDQ. 327. Can you give me the figure in the Chemiker-Kalender?

MR. DAVIS: You need not stress that, Mr. Williams. That figure satisfies us.

RDQ. 328. Take that figure and apply it to the one part of X-cake to a thousand parts of water, and what is the margin of solubility?

A. Well, the figure means one pound and two-thirds is soluble in 1,000 pounds of water.

MR. WILLIAMS: That is all.

I would like to correct in the record, Mr. Stenographer, on page 114 of the record of the day's testimony, four lines from the bottom. It reads: "My work was the testing of oils." The witness said "My work was the testing of ores."

The plaintiff rests.

DEFENDANT'S PROOFS.

MR. DAVIS: If your Honor please, we have a number of exhibits of United States and foreign patents pleaded, which will be discussed by our first witness, and if you approve I will ask Mr. Sage to read them into the record now.

THE COURT: It might be convenient.

MR. DAVIS: That includes some other exhibits.

THE COURT: What is that?

MR. DAVIS: There are some additional exhibits that were attached to a deposition of Bradford, but it seems if we get them all in at once, we will proceed more smoothly when we get to the witnesses.

THE COURT: Very well.

MR. SAGE: I have a typewritten list of these 81 exhibits. It might facilitate matters if I handed counsel a copy and the stenographer the other copy and the exhibits be marked. I don't believe your Honor wants to hear me read this list of patents.

THE COURT: No. I wonder, Mr. Williams, if we cannot facilitate that by submitting a list.

MR. WILLIAMS: I haven't any objection, if I may be given an opportunity to express any objections that I have to the list, after having an opportunity to study it.

THE COURT: It may be so considered. That is, you reserve your right to object?

MR. WILLIAMS: Yes.

MR. SAGE: In the meantime, these are considered as offered in evidence.

THE COURT: Yes.

MR. DAVIS: Mr. Neary reminds me that on these title papers there was reserved an objection. On an examination I find that the documents, which are copies of laws attached to this exhibit No. 3, are referred to in the body of the agreement. That is the things are to happen, according to this law, and I think the whole business ought to go in as one exhibit. Otherwise, I have no objection.

THE COURT: Do you think they ought to offer it?

MR. DAVIS: I think they ought to offer it, just as it is fastened together, with the ribbons here, and without taking it apart.

MR. WILLIAMS: The defendant may offer it without any physical breaking of it up. I am not going to burden the record with that pamphlet on English law.

THE COURT: Well, it seems to be a question simply of who offers it, more or less.

MR. WILLIAMS: I do not think it ought to be an exhibit. I think if there is anything that the defendant wants to copy out from it, we will add it.

MR. DAVIS: I suggest that we leave it as a physical exhibit, with the understanding between counsel that it won't form part of the record, unless I indicate some parts of it that I want to form part of the record.

MR. WILLIAMS: In which case I may have to indicate some other parts that I want.

THE COURT: Very well.

MR. WILLIAMS: That is all right.

MR. DAVIS: We took the deposition of one Bradford, which has to do with the use in Australia, the commercial use, of a process known as the Potter and Delprat process. That is, according to our contention, one of the air-froth flotation processes. Consequently, the testimony has to do with

that aspect of the case; that is the aspect of the scope of the second patent. That deposition was taken at a time when the first patent was in suit, and was aimed at the scope of both of them at that time.

I suppose the ordinary procedure would be for us to read that deposition in evidence.

THE COURT: Yes. It is long, I take it?

MR. DAVIS: It is quite long.

MR. NEARY: There is a great deal of discussion, which might very well be eliminated here. This testimony was taken before a Master, simultaneously with the taking of the testimony in this case, and the arguments were actually made before the Master in another case for the admission of the testimony. Those arguments may be omitted from the reading here, I take it, and if objections are made, possibly we can argue the objections and listen to the evidence as we go along. So that while it will take some time to read it, it is not as formidable as it looks.

THE COURT: See if we cannot shorten it even more than that. If it were not for the matters of objections to questions and other things, I would suggest that that be put in the record. It will be of no especial benefit to me to hear that read over and my reading it later on. If you get that into the record, at the same time saving and getting the benefit of any objections that you have made or intend to make, it might facilitate the progress of the case.

MR. WILLIAMS: That is entirely agreeable. We leave the matter of objections in abeyance. Let him offer it in now and dispense with the reading of it.

THE COURT: Yes.

MR. DAVIS: Is there any objection to Mr. Neary stating what we understand to be the purport of it?

THE COURT: None at all.

MR. NEARY: I took this testimony. At least, I examined the witness who was under examination in this matter, and I had intended to refresh my recollection on what he said. It was taken several years ago, but unfortunately I have not; but generally I know what the subject matter was. I know

what we were aiming at. Mr. Bradford, who was the witness in this deposition, was an Australian who had been the manager of the Broken Hill Proprietary Mine, a large property in Australia, which, from about the year 1903, up until some time in 1917, when the plant was shut down because of strikes there, had continuously operated a process which was a combination of the Potter process and the Delprat process. Those processes were what we contend to be froth processes; that is, concentration of ores resulting in a froth. The ore was crushed, as is described in the patent in suit, and a freely flowing pulp was created, and then there was added to the mixture in one of several different ways, sulphuric acid or some substance of like character, which was said by the witness to act in the way of creating or generating a gas; the gas bubbles bringing the mineral to the surface in much the same way that the air bubbles do in the process of the patent in suit.

The point of this testimony was that this was an existent known process in 1903 and continued throughout all of the period when these plaintiffs were in Australia promoting their own process in competition with it. The testimony as to actual operation was offered with the idea of showing that the patents which were completed were actual existent mill scale operation processes, the processes that go into the mill; and were not merely "paper patents," so to speak.

Now, the testimony of Bradford is to the effect that he was the manager of that plant throughout a large portion of that time, and was connected with the properties during all of the time, that he was also connected with litigation in connection with the patent, and that he knew intimately the type of operation and particularly the things that were done in the plant. He testified that the product of that process was a thick, black, coherent froth, not distinguishable in any way from the froth that was being produced by the Elmore vacuum process, and the Minerals Separation process in other mills operating within the same Broken Hill district. That is, in Australia, there is this Broken Hill district, of which you probably recall some reference being made in the decisions wherein——

MR. WILLIAMS: Mr. Neary, will you pardon me? You unintentionally, perhaps, conveyed the impression that this witness testified that the Elmore vacuum process was actually in use in Australia. He testified that years and years ago it was in use.

MR. NEARY: He identified the exact period, from 1907 until about 1910, and that continuously thereafter his process, that is, the Potter-Delprat process, and the Minerals Separation process, continued in open competition for some considerable period thereafter. That is a fair statement of what was adduced in his deposition.

MR. DAVIS: Mr. Neary suggests, and I concur, that we would be willing to let the objections stand on the arguments that were presented before the Master and that were printed, as I understand, without any ruling of the Master. That is, for your Honor's consideration.

MR. NEARY: Wherever additional reasons for the introduction in this particular case of any testimony is necessary, it can be indicated; so I think the deposition can go forward in that way. Do you not think so? It does not make any difference.

MR. WILLIAMS: I think we should reserve the right to strike out a lot of immaterial matter, and I think I should add to what Mr. Neary has stated there generally, that this testimony, particularly the cross-examination, brought out the fact that these operations were carried out at one mine; practically all the rest of the mines were using the air-froth flotation process, and further than that, this testimony brings out, and it was particularly accentuated in cross-examination, that during all these operations in this one mine for years and years, the slimes were rejected as untreatable by the process.

MR. NEARY: I think the Court can get the real effect of the testimony. I would not agree to that last statement.

THE COURT: Well, I will have your views.

MR. DAVIS: We have a deposition of Mr. Theodore J. Hoover, with a number of exhibits. The occasion and purpose of——

MR. KENYON: Your Honor, just a moment, please. It is understood that we can make additional objections to any of these depositions or questions or matter in the deposition?

THE COURT: Anything in furtherance, you might make all the objections you might wish.

MR. DAVIS: The occasion of the testimony of Mr. Theodore J. Hoover was this: Mr. Hoover was one of the engineers associated with the Minerals Separation, Limited, and while so associated with them, he received from Messrs. Sulman and Picard, engineers of the company—and who were patentees of the agitation froth patent, and Sulman is one of the patentees of the patent in suit—he received from them, in order that he might enlighten himself for his duties with the company, a treatise on "Concentration Processes Involving Surface-Tension." In that treatise was set forth the then known processes with a full discussion of the principles upon which they proceeded, and a classification of them according to those principles.

Mr. Hoover testified that he had received this copy of the treatise and had preserved it, and it was then put in evidence; the deposition being taken primarily in the Miami Accounting Proceedings.

The purpose of the evidence is the treatise alone; not what Mr. Hoover said. That was just a means of identifying or authenticating the treatise. It is admitted here by answers to questions directed to the plaintiff that the plaintiff will not deny that Mr. Hoover did receive the treatise from these men and preserve it without alteration, as he testified that he did, so that its source and authenticity are now admitted.

There is some other testimony in the deposition as to what Hoover did in Australia with these same processes. That deposition is, like the Bradford one, very long, and I suggest that we do the same thing with it that we did with the Bradford deposition.

THE COURT: Yes; I do not think it would be profitable to sit here and hear that read now, because this matter has to be studied in a different way.

MR. GARRISON: It is already marked. We will not object to your introducing the deposition.

MR. DAVIS: We may have occasion to use the exhibit treatise during the examination of our witnesses.

MR. GARRISON: You may do so as far as we are concerned.

THE COURT: That seems to take care of that.

MR. DAVIS: They were marked by the Examiner. How many of them are there?

MR. SAGE: Twelve.

MR. DAVIS: Will you number them consecutively? Give the deposition the first number.

MR. GARRISON: Mr. Davis, the stipulation with respect to our consent to put that in evidence is not here. I think you ought to file it.

MR. SAGE: The stipulation has been filed.

MR. NEARY: As I understand, if your Honor please, the Bradford deposition was taken *de bene esse,* and it was filed here. I believe the correct procedure is to offer that in evidence at this time and that is what I intended at the time that I addressed you.

THE COURT: It was offered, I thought.

MR. NEARY: That is what I intended. I just wanted to be sure that I was right, and that this Hoover deposition is exactly in the same position.

MR. GARRISON: We have some exhibits, if your Honor please, with respect to this Hoover deposition, which we will offer now, if the other side wants them, or put them in later, just as they like.

MR. NEARY: They were marked at the time of the taking of the testimony, and I think they can be put in later.

THE COURT: Whichever is more logical. You can put it in all together.

MR. GARRISON: Just as long as it is understood that we do not waive the right to do it.

(Defendant's Exhibits were received in evidence and marked as follows:)

Bradford's sketches of apparatus used in Broken Hill Proprietary Plant in 1903 received in evidence and marked "Defendant's Exhibit No. 1."

Bradford's sketches of apparatus used in Broken Hill

Proprietary Plant in 1903 received in evidence and marked "Defendant's Exhibit No. 2."

Engineering & Mining Journal—Feb. 16, 1907, pages 317-321—received in evidence and marked "Defendant's Exhibit No. 3."

Australian Mining Standard—August 11, 1904, pages 215, 216, received in evidence and marked "Defendant's Exhibit No. 4."

Australian Mining Standard—August 16, 1904, page 258, received in evidence and marked "Defendant's Exhibit No. 5."

Australian Mining Standard—Sept. 22, 1904, page 429, received in evidence and marked "Defendant's Exhibit No. 6."

Australian Mining Standard—November 3, 1904, page 633, received in evidence and marked "Defendant's Exhibit No. 7."

Australian Mining Standard—February 23, 1905, page 262, received in evidence and marked "Defendant's Exhibit No. 8."

Australian Mining Standard—November 24, 1904, pages 742, 743, received in evidence and marked "Defendant's Exhibit No. 9."

Australian Mining Standard August 4, 1904, page 162, received in evidence and marked "Defendant's Exhibit No. 10."

Australian Mining Standard, October 13, 1904, page 532, received in evidence and marked "Defendant's Exhibit No. 11."

Australian Mining Standard, December 15, 1904, page 835, received in evidence and marked "Defendant's Exhibit No. 12."

British Patent No. 488 of 1860 to William Haynes, "Obtaining Metals from Ores" received in evidence and marked "Defendant's Exhibit No. 13."

German Patent No. 42 of 1877 to Bessel Brothers, "Process for the Purification of Graphite" and stipulated translation thereof received in evidence and marked "Defendant's Exhibit No. 14."

German Patent No. 39,369, of 1886, to Bessel Brothers, "Process for the Mechanical Purification of Graphite from its Earthy Admixtures" received in evidence and marked Defendant's Exhibit No. 15."

United States Patent 348,157 to Carrie J. Everson patented August 24, 1886—"Process of Concentrating Ores" received in evidence and marked "Defendant's Exhibit No. 16."

British Patent No. 24,144 of 1892 to Joseph W. Sutton, "Improvements in the Separation of Gold from its Chloride Solution," received in evidence and marked "Defendant's Exhibit No. 17."

British Patent No. 427 of 1894 to George Robson and Samuel Crowder, "Treatment of Finely Divided Substances, such as Crushed Ores, Slime, Tailings, and the Like, for the Separation and Recovery of Metals and Metallic Compounds Therefrom, and Apparatus Therefor" received in evidence and marked "Defendant's Exhibit No. 18."

British Patent No. 2538 of 1895 to George Robson and Samuel Crowder, "Improvements in the Treatment of Finely Divided Substances, such as Crushed Ores, Slime, Tailings, and the Like, for the Separation and Recovery of Metals and Metallic Compounds Therefrom," received in evidence and marked "Defendant's Exhibit No. 19."

United States Patent No. 575,669, to George Robson, patented January 19, 1897—"Separation of Metals and Metallic Compounds from Ores or Other Substances," received in evidence and marked "Defendant's Exhibit No. 20."

United States Patent No. 703,905 to Elmore—patented July 1, 1902—"Apparatus for the Separation of Minerals by the Selective Action of Oils, etc." received in evidence and marked "Defendant's Exhibit No. 21."

United States Patent 776,145 to Potter—patented November 29, 1904—"Process of Separating Metals From Sulfide Ores," received in evidence and marked "Defendant's Exhibit No. 22."

United States Patent No. 735,071, to Delprat, patented August 4, 1903—Extraction of Zinc, Lead, and Silver Sul-

fides, from their Ores," received in evidence and marked "Defendant's Exhibit No. 23."

United States Patent 768,035, to Delprat—patented August 23, 1904—"Extracting Zinc or other Sulfides from their Ores," received in evidence and marked "Defendant's Exhibit No. 24."

British Patent No. 19,783 of 1903 to Delprat—"Improvements in Extracting Zinc and Other Sulfides from their Ores," received in evidence and marked "Defendant's Exhibit No. 25."

British Patent No. 27,132 of 1903 to Delprat—"Improvements in Extracting Zinc and Other Sulfides from their Ores," received in evidence and marked "Defendant's Exhibit No. 26."

New South Wales Patent 13,939 of 1904 to Delprat—"Improved Apparatus for the Treatment and Recovery of Sulfide and Other Ores treated by a Liquid Process," received in evidence and marked "Defendant's Exhibit No. 27."

New South Wales Patent 13,940 of 1904 to Delprat—"Improved Apparatus for the Treatment and Recovery of Sulfide and Other Ores treated by a Liquid Process," received in evidence and marked "Defendant's Exhibit No. 28."

South Australia Patent No. 6493/1904—Delprat—"Improved Apparatus for the Treatment and Recovery of Sulfide and Other Ores Treated by a Liquid Process," received in evidence and marked "Defendant's Exhibit No. 29."

South Australia Patent No. 6494 of 1904 to Delprat—"Improved Apparatus for the Treatment and Recovery of Sulfide and Other Ores Treated by a Liquid Process," received in evidence and marked "Defendant's Exhibit No. 30."

British Patent No. 12,778 of 1902 to Alcide Froment—"Improvements relating to the Concentration of Ores," received in evidence and marked "Defendant's Exhibit No. 31."

British Patent No. 26,295 of 1902—to Cattermole—"Improvements in the Separation of the Metallic Constituents of Ores from Gangue," received in evidence and marked "Defendant's Exhibit No. 32."

United States Patent 763,259 to Cattermole—patented June 21, 1904—"Classification of the Metallic Constituents of Ores," received in evidence and marked "Defendant's Exhibit No. 33."

United States Patent 763,260, to Cattermole—patented June 21, 1904—"Separation of the Metallic Constituents of Ores from Gangue," received in evidence and marked "Defendant's Exhibit No. 34."

United States Patent No. 777,273, to Cattermole—patented December 13, 1904—"Separation of the Metallic Constituents of Ores from Gangue," received in evidence and marked "Defendant's Exhibit No. 35."

British Patent No. 17,109 of 1903 to Cattermole, Sulman, Picard—"Improvements in or relating to the Concentration of Minerals from Ores," received in evidence and marked "Defendant's Exhibit No. 36."

United States Patent 777,274, to Cattermole, Sulman, Picard—patented December 13, 1904—"Concentration of Minerals from Ores" (soap granulation patent), received in evidence and marked "Defendant's Exhibit No. 37."

United States Patent 788,247, to Cattermole, Sulman, Picard—patented April 25,1905—"Ore Concentration (soap flotation patent), received in evidence and marked "Defendant's Exhibit No. 38."

German Patent No. 163,750, of 1904—to Cattermole, Sulman, Picard—"Process for the Separation of Ores from their Gangue, by use of Fatty Acids and the Like, and Water, in which the Fatty Acid coats the Ore Particles and stipulated translation thereof, received in evidence and marked "Defendant's Exhibit No. 39."

United States Patent No. 793,808 to Sulman & Picard—patented July 4, 1905—"Ore Concentration," received in evidence and marked "Defendant's Exhibit No. 40."

British Patent No. 20,419 of 1903 to Sulman & Picard—"Improvements in the Separation of Minerals from Ores and Gangue," received in evidence and marked "Defendant's Exhibit No. 41."

British Patent No. 29,374 of 1904 to Sulman-Picard-

Ballot—"Improvements in the Separation of Metalliferous Minerals from Gangue," received in evidence and marked "Defendant's Exhibit No. 42."

United States Patent No. 879,985 to Sulman-Picard-Ballot—patented February 25, 1908—"Separation of Metalliferous Minerals from Gangue," received in evidence and marked "Defendant's Exhibit No. 43."

United States Patent No. 805,382 to Sanders—patented November 21, 1905—"Process of Concentrating Ores." received in evidence and marked "Defendant's Exhibit No. 44."

United States Patent No. 807,502, to Schwarz—patented December 19, 1905—"Process of Concentrating Ores," received in evidence and marked "Defendant's Exhibit No. 45."

United States Patent 809,959 to Kirby—patented January 16, 1906—"Process of Separating Minerals," received in evidence and marked "Defendant's Exhibit No. 46."

British Patent 17,816 of 1904 to Elmore—"Improvements in Processes for Separating Certain Constituents of Finely Divided Material by Causing them to Rise or Float in a Liquid," received in evidence and marked "Defendant's Exhibit No. 47."

United States Patent No. 826,411 to Elmore, patented July 17, 1906—"Process for Separating Finely Divided Material," received in evidence and marked Defendant's Exhibit No. 48."

Australian Patent No. 1935 of 1904 to Elmore—"Improvements in Processes and Apparatus for Separating Certain Constituents of Finely Divided Material by Causing them to Rise or Float in a Liquid," received in evidence and marked "Defendant's Exhibit No. 49."

British Patent No. 1821/1905 to Sulman-Picard-Ballot—"Improvements in or Relating to the Wet Separation of Minerals," received in evidence and marked "Defendant's Exhibit No. 50."

Australian Patent No. 4655 of 1905 to Sulman-Picard-Ballot—"Improvements in or Relating to the Wet Separation of Minerals," received in evidence and marked "Defendant's Exhibit No. 51."

British Patent No. 5953 of 1905 to Elmore—"Improvements in Processes for Separating Certain Constituents of Finely Divided Material by Causing them to Rise or Float in a Liquid," received in evidence and marked "Defendant's Exhibit No. 52."

British Patent No. 7803 of 1905, to Sulman-Picard-Ballot—"Improvements in or Relating to Ore Concentration," received in evidence and marked "Defendant's Exhibit No. 53."

United States Patent No. 835,120 to Sulman-Picard-Ballot—patented November 6, 1906, "Ore Concentration," received in evidence and marked "Defendant's Exhibit No. 54."

Certified Copy of: (1) The complete specification and drawings as originally filed and accepted ;(2) the amended specification as allowed on the 11th of December, 1912; (3) the letters patent as issued on the twenty-seventh October, 1905, and (4) the certificate as issued in connection with the registering as subsequent proprietors of Minerals Separation Limited on the third May 1911, in respect of an application No. 19,633 for letters patent made by Sulman, Picard, Ballot for "Improvements in or Relating to Ore Concentration," received in evidence and marked "Defendant's Exhibit No. 55."

Pages 1815, 1817, 1824 and 1825 of Supplement to the New Zealand Gazette of July 27, 1905, received in evidence and marked "Defendant's Exhibit No. 56."

Title page and page 229, New Zealand Patent Office Journal October 31, 1912, received in evidence and marked "Defendant's Exhibit No. 57."

Title page and page 312, New Zealand Patent Office Journal December 12, 1912, received in evidence and marked "Defendant's Exhibit No. 58."

United States Patent No. 835,143, to Sulman—patented November 6, 1906—"Ore Concentration," received in evidence and marked "Defendant's Exhibit No. 59."

United States Patent 835,479 to Sulman, Picard, Ballot—

patented November 6, 1906—"Ore Concentration," received in evidence and marked "Defendant's Exhibit No. 60."

British Patent No. 10,475/1905 to Morgan Crucible Company—"Improvements in the Treatment of Non-Metalliferous Ores or the like for the Separation of Their Constituents," received in evidence and marked "Defendant's Exhibit No. 61."

British Patent No. 15,119 of 1905 to MacQuisten—"Improvements in the Separation of Solid Particles from Each Other," received in evidence and marked "Defendant's Exhibit No. 62."

United States Patent 865,194 to MacQuiesten—patented September 3, 1907—"Process for Separating Solids," received in evidence and marked "Defendant's Exhibit No. 63."

United States Patent No. 865,195 to MacQuiesten—patented September 3. 1907—"Apparatus for Separating Solid Particles from Each Other," received in evidence and marked "Defendant's Exhibit No. 64."

Australian Patent No. 4128 of 1905 to MacQuiesten—"Improved Apparatus for Separating Solid Particles from Each Other," received in evidence and marked "Defendant's Exhibit No. 65."

Australian Patent No. 5738 of 1906 to Sulman—"Improvements in or Relating to Ore Concentration," received in evidence and marked "Defendant's Exhibit No. 66."

British Patent No. 8567 of 1907 to Chapman—"Improvements in the Separation of Certain Non-Metallic from Other Mineral Substances," received in evidence and marked "Defendant's Exhibit No. 67."

Certified and printed copies of British Patent No. 26,852 of 1908 to Minerals Separation, Limited (a communication from Arthur Howard Higgins), "Improvements in or Relating to the Concentration of Ores," received in evidence and marked "Defendant's Exhibit No. 68."

Australian Patent No. 16,568 of 1909 to Minerals Separation, Limited—"Improvements in or Relating to the Concentration of Ores," received in evidence and marked "Defendant's Exhibit No. 69."

Certified and printed copies of British Patent No. 28,173 of 1908—Sulman, Picard, Ballot—"Improvements in or Relating to the Concentration of Ores," received in evidence and marked "Defendant's Exhibit No. 70."

United States Patent No. 955,012 to Sulman—patented April 12, 1910—"Concentration of Ores," received in evidence and marked "Defendant's Exhibit No. 71."

Certified copy and file wrapper contents and drawings of United States Patent 555,012 to Sulman—patented April 12, 1910—"Improvement in Concentration of Ores," received in evidence and marked "Defendant's Exhibit No. 72."

Australian Patent No. 16,601 of 1909—to Sulman, Picard & Ballot—"Improvements in or Relating to the Concentration of Ores," received in evidence and marked "Defendant's Exhibit No. 73."

German Patent No. 226,096 of 1909 to Minerals Separation, Limited—"Process for Concentrating Ores in Acidified Water in which Certain Constituents are caused to float in the form of a froth" and stipulated translation thereof, received in evidence and marked "Defendant's Exhibit No. 74."

Certified copy British Patent No. 2359 of 1909 to Greenway, Sulman & Higgins—"Improvements in or relating to the Concentration of Ores," (as accepted March 1, 1910), received in evidence and marked "Defendant's Exhibit No. 75."

Certified and printed copies of British Patent No. 2359 of 1909 to Greenway, Sulman & Higgins—Improvements in or Relating to the Concentration of Ores (as amended under Section 8 of the Patents and Designs Act, 1907), received in evidence and marked "Defendant's Exhibit No. 76."

Australian Patent No. 13,947 of 1909 to Sulman, Greenway & Higgins—"Improvements in or Relating to the Concentration of Ores," received in evidence and marked "Defendant's Exhibit No. 77."

The Mining Journal—May 11, 1907, page 623—"The Vacuum Process for Concentration of Ores," received in evidence and marked "Defendant's Exhibit No. 78."

The Engineering & Mining Journal—May 11, 1907, pages 908 and 909—"Vacuum Flotation Process for Concentra-

tion," received in evidence and marked "Defendant's Exhibit No. 79."

The Engineering & Mining Journal—June 1, 1907, pages 1037 and 1038—"Novel Equipment of Tywarnhaile Copper Mine," received in evidence and marked "Defendant's Exhibit No. 80."

The Engineer—May 10, 1907—pages 469 and 470—"Ore Concentration by Oil," received in evidence and marked "Defendant's Exhibit No. 81."

Printed Copy Bradford's Deposition and Exhibits (including Defendant's Exhibits Nos. 1 to 12 inclusive,) received in evidence and marked "Defendant's Exhibit No. 114."

Deposition of Hoover received in evidence and marked "Defendant's Exhibit No. 82."

Hoover No. 1 received in evidence and marked "Defendant's Exhibit No. 83."

Hoover No. 2 received in evidence and marked "Defendant's Exhibit No. 84."

Hoover No. 3 received in evidence and marked "Defendant's Exhibit No. 85."

Hoover No. 4 received in evidence and marked "Defendant's Exhibit No. 86."

Hoover No. 5 received in evidence and marked "Defendant's Exhibit No. 87."

Hoover No. 6 received in evidence and marked "Defendant's Exhibit No. 88."

Hoover No. 7 received in evidence and marked "Defendant's Exhibit No. 89."

Hoover No. 8 received in evidence and marked "Defendant's Exhibit No. 90."

Hoover No. 9 received in evidence and marked "Defendant's Exhibit No. 91."

Hoover No. 10 received in evidence and marked "Defendant's Exhibit No. 92."

Hoover No. 11 received in evidence and marked "Defendant's Exhibit No. 93."

Hoover No. 12 received in evidence and marked "Defendant's Exhibit No. 94."

ARTHUR FAY TAGGART, called as a witness on behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION

By MR. DAVIS:

Q. 1. What is your occupation, Mr. Taggart?

A. Professor of Ore Dressing at Columbia University.

Q. 2. Please state your training and experience which qualify you to testify about ore dressing and particularly about air-froth flotation.

A. I studied mining and geology at Stanford University, and studied ore dressing particularly under Professor Richards at the Massachusetts Institute of Technology. I obtained the degree of Bachelor of Arts in Mining, and Engineer of Mines, from Stanford University. Since leaving the University I have worked principally at various tasks connected with ore dressing and have taught ore dressing both at Yale University and at Columbia University. I have studied the various processes of froth flotation practically continuously for six or seven years.

Q. 3. Will you please give us a brief review of the art of concentration of ores by flotation with flotation agents which have a preferential affinity for metalliferous particles?

A. There have been many different processes for the concentration of ores, in which valuable minerals of metallic and adamantine lustre are separated from worthless minerals of earthy or rocky lustre, described and used in ore dressing practice within the last fifty or sixty years. The first mention in metallurgical literature of processes involving this separation is made in a patent issued to Haynes, in England, Patent No. 488, of 1860.

In this patent Haynes described a process in which finely ground ore was mixed with bituminous matter. This mixture was then placed in water and run through a grinding or kneading machine, and this treatment had the effect of causing the worthless matter to drop out of the oily mass and to cause the sulphide matter to remain in the oily mass, and subsequently it was possible to separate the oily matter containing

the sulphide material from the muddy water containing the gangue by floating the material off.

The specific oily substances named by Haynes are coal tar from gas works, gums or gummy matter, gutta percha, India rubber and fatty or oleaginous matter.

The next step in advance in this type of separation was a long one. It was taken by Bessel Brothers in Germany and is described in the German Patent No. 42 of 1877. The operation that is therein described is one in which an ore containing graphite (which is one of these minerals that has the peculiar metallic luster that allows it to be separated from the rocky gangue) is mixed with one or more oily substances named in the patent, and then introduced into water, and the resulting pulp heated up to lively boiling. As a result of this operation, the graphite rises to the surface of the mass in the form of a coherent froth or scum, and is drawn off, while the worthless rocky material remains submerged in the liquid, and a separation is thus effected. Bessel Brothers named a very considerable list of oily selective agents in this patent as being suitable for use, and as being agents that would produce this particular kind of froth separation. These substances are as follows:

All fatty oils and solid fats of the animal and vegetable kingdom, and the fatty acids obtainable therefrom.

All essential oils.

All resins of the vegetable and mineral kingdom, their solutions, and the oils obtainable therefrom by dry (destructive) distillation.

The Caoutchouc bodies, their solutions, and the oils obtainable therefrom by dry (destructive) distillation.

The so-called balsams of commerce.

Crude and refined petroleum, the by-products of the refining, both the more volatile ones, as ligroin, petroleum spirit and petroleum ether, as well as the less volatile ones, the so-called vulcan and machine oil.

Tar from brown coal, anthracite coal, wood and peat, and also the oily products of the distillation of these tars, as well as the residues remaining from the distillation.

Pitch of commerce; paraffin wax, benzine, potato fusel oil.

Beeswax and vegetable wax, also oils obtainable therefrom by dry (destructive) distillation.

Mineral oil and mineral tar; ozokerite, spermaceti, bone oils obtainable by dry (destructive) distillation, as well as by boiling bones. Cheeses of commerce. Finally, mixtures and solutions among each other of the bodies heretofore referred to.

The physical steps and phenomena leading up to the separation by this process are:

1. Making a freely flowing pulp of finely ground ore and water and the requisite quantity of a desired oily substance.

2. Heating this mixture, as a result of which gas bubbles are generated from solution in the water of the pulp and precipitate preferentially onto the mineral of metallic luster, and buoy it to the surface of the pulp where the bubbles with their load of mineral collect in the form of a coherent froth or scum.

3. The separation of this floating froth by skimming or other suitable means.

This is the first of a large class of froth-flotation processes that are called pulp-body processes, because of the fact that the concentration in these processes is effected at the surfaces of gas bubbles down in the body of the pulp that is being treated, and subsequently these bubbles rise, with their load of mineral, with their task of concentration finished, to the surface of the pulp, emerge from the surface of the pulp with a load of sulphide on them, there collect in the form of a froth that usually is of a coherent and fairly stiff character, and then are easily separable from the pulp.

The next patent in chronological order that utilizes the preferential affinity of oily substances for minerals of metallic luster over gangue is the Everson Patent No. 348,157, United States of 1886.

Two methods of operation are described in this patent. In the first, an oily substance is made, of a rather peculiar kind, by treating cottonseed oil with concentrated sulphuric

acid, and thereafter adding to this mixture water in sufficient quantity that there is formed a whitish, oily mass of rather salve-like consistency. This is then kneaded into the dry ore, and then the mass of dry ore, with this material distributed through it, is put into water containing a small amount of acid, and kneaded around therein. The result here is practically the same, as far as the general principles are concerned, as in the Haynes process. That is the worthless minerals—the rocky gangue—drops out, the particles come to the interface between this oily mass and the water and drop out, so that a remarkably clean separation is made thereby, and the oily mass remains with the sulphide mineral particles in it. This is then separated—assuming that it has been broken up—by floating it off, leaving the worthless material in the bottom. As this material comes off, it can be seen to contain a certain amount of air bubbles that add their effect to the buoyant effect of the oil in raising the sulphide particles.

In the other method described by Everson an oil or oily substance, not prepared in this particular way, is mixed with dry ore, and the mass is subsequently stirred up with acidulated water, and the sulphide mineral particles floated with some oil, and with, in general, rather more bubbles attached to them than there were in the previous case, and are separated. I do not think that anybody would call the mass that is separated here a froth at all. There are undoubtedly air bubbles present that aid in the levitation of the mineral, but there is not the thing that is understood in flotation practice as a froth. The particularly important thing that Everson disclosed in the art was the addition of acid to the pulp, in order to increase, as she said, the preferential or selective affinity of the oily substance for the metalliferous matter over gangue, and the effect of the acid certainly is to give a cleaner concentrate; in some cases also to leave less of the valuable material in the tailing or worthless part of the pulp. Everson specified a considerable number of oily substances, as a fat or an oil, either animal, mineral or vegetable, or a fatty constituent or acid of an animal or vegetable fat or oil, or any constituent of a mineral oil. Further, petro-

leum and one of its several constituents, namely, paraffin oils. Also tallow (melted) lard, lard oil, red-oil (meaning thereby impure oleic acid), cottonseed oil, castor-oil, sperm-oil and linseed oil, and combinations of these with each other. She also named a considerable number of acids that could be used in conjunction with the oily substances, in order to increase the preferential affinity of the oily substance for mineral matter. She said either a mineral or vegetable acid or a soluble neutral or acid salt, and named specifically sulfuric acid, hydrochloric acid, nitric acid, phosphoric acid, acetic acid, oxalic acid, tannic acid, and gallic acid, also some of the inorganic salts, as the sulphates and chlorides of sodium, zinc and copper and the double sulfate of potash and alumina.

The next process that is described after Everson, was another great step forward in this art. I have reference to the process of Bessel Brothers, described in the patent issued to Bessel Brothers, No. 39,369, in 1886 in the German Empire. This process was one in which the powdered ore and water and an oily substance were mixed together, into what we call a freely flowing pulp, and there was then incorporated with this a certain amount of chalk (calcium carbonate). There was subsequently added to the mixture, an acid, and the particular one named is hydrochloric acid. The purpose of the addition of these two last substances was to bring about a chemical re-action between the calcium carbonate and the hydrochloric acid that would result in the evolution of carbon dioxide gas, and this gas floated the oily metalliferous mineral particles to the surface and did not attach to the gangue particles. The bubbles with their mineral load, after arriving at the surface, collected there as a coherent froth and could then be separated from the tailing pulp.

This is another one of that same kind of processes that was described in the first Bessel patent. It is a pulp-body process, in which the attachment of mineral particles to gas is effected in the body of the pulp below the surface, and the bubbles rise with their duty of concentration complete as they emerge through the surface of the pulp.

Q. 4. Will you just read what the patent says about the

first process? It refers back to the first Bessel process right at the beginning. I want to get the first sentence of the specification onto the record .

A. "The mode of manufacture which has come into use at the present time in our new graphite dressing process, consists in intimately mixing the dry graphite mass with those substances which we have mentioned in our first patent, No. 42; especially we now use bitumens. The quantity of these additions is determined according to the quality of the graphite, and does not permit itself to be stated in definite quantitative proportions."

Q. 5. Now proceed.

A. This particular method of effecting pulp body concentration, however, utilizes a different method of generating the gas in the pulp. In the first Bessel process the gas was generated—that is, precipitated out of solution in the water of the pulp—by heating the pulp. In this it is generated by the reaction between these two substances, chalk and acid, and the peculiar thing about this particular method of generation is that the gas bubbles do not generate at the surface of the carbonated particles and then meander around through the pulp and come into contact with the sulfide particles and adhere to them, and pick them up and raise them to the surface, but as the gas generates at the surface of the carbonate particles it passes into solution in the water, and thus brings about a condition of super-saturation of the water with respect to other surfaces, not carbonate surfaces, so that as the liquid that is now in contact with the corbonate particle that was generating the gas moves with the natural movement of the pulp over into contact with a sulfide particle, that gas, that went into solution at the point it was generated, precipitates onto the surface of the sulfide particle, selectively and preferentially, and adheres thereto and raises it to the surface.

In this second Bessel patent there is specified also the heating of the water to from 30 degrees C. to 40 degrees C. This heating aids materially in the operation of these pulp-body processes. In all of them gas can more quickly and

more thoroughly, when the pulp is heated, be made to precipitate on the oily substances.

The oily substances named specifically in this patent are naphthas or bitumens, and they mention certain bitumens such as crude and refined petroleum and the by-products of the refining process, paraffin, benzine, mineral oil, mineral tar, ozokerite. They state also that fusel oil is one of the substances that is effective in the operation.

Q. 6. What is fusel oil?

A. Fusel oil is a mixture of alcohols, principally amyl alcohol. Continuing, they state also that the quantity of the oily substance that is to be added cannot be stated definitely, because it depends upon the kind of gangue that is associated with the graphite, but that at least 1 per cent. reckoned on the weight of the ore will be necessary.

The next patent in order that utilizes preferential affinity of oily substances for metalliferous matter—for collecting the metalliferous matter—is one issued to Sutton, British Patent No. 24,144 of 1892. In this is described a process that utilizes the tendency of certain specific agents, mineral oil, such as kerosene or volatile hydrocarbon fluids, as they are described (meaning apparently, from the substances subsequently mentioned, oily substances), or a resin, preferably turpentine. Now, this particular process was not one in which metallic mineral was to be separated from gangue, but one in which precipitated gold, which is, of course, a metal, was to be picked up in water, because of the tendency of the oily substance to go onto the gold and collect it together in the mass of the oily substance and float it away.

Robson and Crowder in British Patent 427 of 1894, describe another process in which the preferential affiinity of oily substances for mineral matter over gangue in the presence of water is utilized for separation. The oily substances that they mention are "a mixture of a liquid hydrocarbon such as turpentine, petroleum, paraffin, or the like, and a fatty oil, such as colza oil."

The same inventors, in British Patent 2,538 of 1895, describe a variant of the process just mentioned, applicable to

certain ores, in which the same oily substances are mixed with the ore in a dry state before the addition of water to form the pulp in which the final separation is made. That is, in one of the patents they added the oil to a wet pulp, and in the other one to a dry pulp and subsequently added the water. In this patent they describe also the use of soap and water to replace the colza oil or any other fatty oil in the mixture of oily substances specified in the earlier patent, and they describe in United States Patent No. 575,669, granted January 19, 1897, a process similiar to that described in the first British patent mentioned to them.

Froment, in British Patent 12,778 of 1902, describes a process of pulp-body concentration similar to that described by Bessel Brothers in the German Patent No. 39,369 of 1886—that is, the second Bessel patent. It is what we call a chemical generation process, because of the fact that the gas for the sulfide particles is generated by a chemical reaction.

The steps of Froment's process are the formation of a freely-flowing pulp, selective oiling of the sulfide particles by various oily substances, liberation of gas from solution in the water of the pulp, the liberated gas precipitating preferentially upon the oiled sulphide particles, and collection of the mineral-coated gas bubbles in the form of a coherent froth or scum at the surface of the pulp.

Froment describes one method of performing this operation in his patent, and I have read of a large scale method of operation in volume 4 of the record of the case of Minerals Separation v. the Miami Copper Company, the small scale laboratory operation being quite different from that described in the larger apparatus, in so far as the actual carrying out is concerned, but the same kind of a thing absolutely in principle. The oily substances for use in Froment are designated as "a suitable oil" or "ordinary oil." These terms mean to the man skilled in the art, of course, any one of the large class of oily substances comprised under the general term of oily substances and specifically named in these various patents that I have recited so far, in which the field of oily substances has been very thoroughly explored.

Cattermole, in British Patent 26,295 of 1902, described a process for utilizing the preferential affinity of oily substances for metalliferous matter over gangue in the presence of water, in which the separation of oiled particles was made by causing them to sink, rather than to float as had been done in these earlier processes. In this process a finely ground ore of the same size, of course, as has been used in the earlier processes, is mixed with water and agitated violently with a small amount of an oily substance, and as a result of this agitation the oiled mineral particles are agglomerated together in the form of irregular flocks and rounded granules, and these thus agglomerated masses are much heavier, so that they will settle much more rapidly in water (they are much heavier, of course, than the small individual mineral particles, although somewhat less in specific gravity than these individual particles; anyway, they will settle in water much more rapidly) than the small mineral particles will, and, therefore, very much more rapidly than the small gangue particles will. If, therefore, this mass, after these granules or flocks or mineral masses have been formed in it, is subjected to any one of a considerable number of apparatus, well known in the concentrating art, that utilizes one of the different methods of falling in water for separation of the mineral particles, a separation can be effected between the agglomerated valuable particles and the gangue.

Cattermole mentions very broadly the oily substances that are useful in the process that he describes. He says that any animal, vegetable or mineral oil, which alone or in conjunction with an emulsifying agent—that is a substance that will cause this oil to be thoroughly dispersed as fine granules throughout the mass of the pulp—has the property of picking up metallic mineral particles. He gives some examples, linseed oil, lard oil, paraffin, or light hydrocarbon oil, heavy hydrocarbon oil, preferably mixed with a fatty acid or fatty oil. He names several emulsifying agents, soap, oleic acid, alone or partially saponified with alkali, or other substances which froth on agitation with water, this being the particular property that marked his emulsifying agent.

Substantially the same process is described in United States Patent 763,260, issued to Cattermole June 21, 1904. In this patent, in discussing the oily substances having the desired selective action, Cattermole calls for use of "certain tar products or similar compounds (all hereinafter referred to as 'oil.')" That is, it was the common practice in the art at that time—this wide class of oily substances having been disclosed and named and being known to the art—to class all of them that had the preferential affinity, and that would cause the granulation or would pick out the particles in the mass, or would aggregate them together in the form of a froth, oil; and he says that "The oil used may be animal, vegetable, or mineral oil, or mixtures of these, or such coal or wood tar products or other substances which exercise, like oils, a preferential physical affinity for metallic mineral matter as distinguished from gangue." And in this United States patent also he goes into a little more detail in connection with the emulsifying agent. He says it is soap, alkaline cresylates or other substances—that is compounds that are formed, for instance, with some of these coal and wood tar products, when they are treated with alkali—soloutions of which in water froth on agitation. He says further that the emulsifying agent appears to have a decided effect in bringing about the granulation described. That is, the emulsifying agent not only gets the material dispersed through the water, because you can do that by agitation, but it also aids in bringing about this preferential affinity that is essential, and the bringing together of the particles into flocks and granules. Further he says:

> "as with wood tar and some coal tar products, these when agitated in weak alkaline solutions provide their own emulsifying agents, soluble resinates, cresylates, etc., being thereby formed, which emulsify the bulk of the tar or product.
>
> "Emulsification in some cases, as with the heavier residuum oils or tars, may be assisted by first mixing therewith a small amount of fatty oil or fatty acid."

Another one of these Cattermole patents is No. 777,273,

granted in this country on December 13, 1904, and in this a process similar to the other two is described, except that in this the pulp is made acid, while no such direction appears in the others. To make the selective action of the oily substance more marked, mineral, fatty or other acid may be used according to the specifications.

In patent No. 777,274, which was issued to Cattermole, Sulman & Picard, December 13, 1904, in this country, the granulation process is again described, but with a new means of introducing the selective agent into the pulp. They had previously depended upon either agitation or the addition of this emulsifying agent and oil to disperse the selective agent. Here they describe a process in which the selective agent is made into a soap or similar compound, as they call it, by preliminary treatment with an alkali. That is, it is treated with an alkali in order to make a soft soap. For the wood-tar products in which cresol occurs, if they are treated with alkali we get a compound that is similar chemically to the sodium oleate, as it is called, or soap that is made by oleic acid with an alkali, and this compound is readily soluble in the water of the pulp. In such form, of course, it disperses readily and completely throughout the pulp. Then it is precipitated by the addition to the pulp of a mineral acid. That is, a mineral acid put in there will break up this soap or similar compound—break it up and unite with a part of it and bring back the oleic acid or cresol, as the case may be. The selective agents named in this patent are fatty or resin acids or certain other aromatic derivatives, such as cresols, phenols, etc. The same kind of granules are formed in this process.

The addition of the oily substance to a freely flowing pulp, which has been described in these recent patents, was first described in a patent issued to Elmore, United States Patent No. 676,679, issued June 18, 1901, in the United States. In a later apparatus patent dealing with the same type of process, namely patent 703,905, issued July 1, 1902, Elmore defined an oil, as it was then understood by the men skilled in the art, "to mean either oil or any other substance that can exert a selective action on minerals such as oil exerts."

He also summarized the knowledge of the men skilled in the art as to the kind of particles that were floated selectively by oily substances in the following words: "The oil by its selective action coats or absorbs the metallic particles, sulfids, tellurides,"—those are chemical compounds quite similar to sulfids, in which a metal combines with tellurium instead of sulphur to form this mineral—"and the like. Also, if plumbago, elementary sulphur, or other substances of like character are present, the oil attaches itself to or coats such particles, while it does not coat or attach itself to the rocky or earthy products present." Plumbago is another name for graphite.

In 1903, patent No. 735,071, issued in this country to Delprat, disclosed a method of froth-flotation that is further described in United States Patent No. 768,035, issued to Delprat on August 23, 1904, and United States Patent No. 776,145 issued to Potter November 29, 1904, and in various British and Australian patents issued about the same time to these men. In this particular group of patents, the finely pulverized ore again was put into a box, dropped into a box, or flowed into a box, with a relatively strong solution of an acid, an inorganic acid or an acid and an inorganic salt. That is, such substances as sulphuric acid, hydrochloric acid, nitric acid, nitrates and other salts, acid sodium sulphate or acid salt cake, or mixtures of acids and salts; and the solution is hot, between 80 and 90 degrees C., that is, very near to boiling. As a result of this treatment the mineral products rise to the surface in the form that is now familar, coherent froth or scum, and are floated off, while the remaining worthless material is drawn off through a hole in the bottom of the container, so that material comes continuously into this machine, overflows continuously, and the tailing, so-called, is discharged continuously.

These processes were first applied in Australia, in connection with an ore there that contained small amounts of carbonate minerals. Whether or not they are limited to ores that contain carbonate minerals, they certainly work best with such ores. Now, these processes, or these various ways

of operating the same process, are chemical generation processes, with some heating effect also probably, but there is no oily substance added to the pulp at all.

Early in 1905, April 25, 1905, patent No. 788,247 was issued to Cattermole, Sulman & Picard for an operation in which a fatty or resin acid, or a phenol, or a cresol, was precipitated from the alkaline compounds of these substances —and this is the same thing as the patent No. 777,274 in so far as the dispersion of the substance is concerned—by a mineral acid. Subsequently the mineral particles which, following the precipitation of these substances had become coated with them, were to be separated by granulation, as described in these Cattermole patents that we have already mentioned, or by flotation with gas bubbles, as, for instance, in the chemical generation process of Froment previously described. They also mentioned other methods by which the mineral particles could be floated as, for instance, running a metallic band or an oil belt down through this mass of pulp with the expectation that the coated particles would adhere to this oiled belt, and be dragged up and be scraped off, and they also mention putting in sawdust that had been coated or various other buoyant substances and picking them up in that fashion.

The essence of this last invention—the essence of the invention described in this last patent, according to the statement of two at least of the patentees is, according to their treatise, page 218;——

> "this device enables the smallest quantity of oily material to be efficiently applied either for purposes of flotation or granulation. Oil when added *as such* to the pulp through which it is to be rapidly and almost molecularly disseminated in order to uniformly coat each and every sulfide particle with a thin oil film, offers considerable difficulty to the realization of these requirements; the sufficiently close quantification and the rapid mechanical break-up of small quantities of 'neat' oil is not easily attained. The result is non-uniform oiling of the particles which means insufficiently sharp separation. But by employing the oil in the shape of a so

solution, which may thus be of any desired dilution, and adding this to the acidified pulp, the oil is at once precipitated throughout the pulp mass in a condition of almost molecular fineness, and permits practical uniformity of the oil-coating."

Now, in the English equivalent of this patent, British Patent No. 17,109 of 1903, at page 3, line 3, the same thought is expressed in this statement:

"Thus liberating in a state of chemical subdivision the fatty or resin acid or other compound such as cresol, etc., in intimate contact with the suspended ore particles. It is found that the liberated acids, etc., which may even be solid under ordinary conditions, are precipitated and adhere to the sulphurreted minerals, or to sulphur, graphite, or free metals present in the ore, leaving the gangue . . . free from adhesions of fatty acid and the like."

Now, no new method of flotation, ,no new method of granulation or anything is described in this patent, but it is here specifically pointed out to the art that phenol and cresol in a state of chemical subdivision—that is, in solution in the water—will adhere preferentially to the sulphide mineral particles and give the oily coating that is essential for the attachment of gas to them in the body of the pulp, to float them to the surface in the form of a froth. In these pulp-body processes that these men know——

Q. 7. Professor Taggart, you said there that the expression "chemical subdivision" was the equivalent of the expression "in solution." Will you please develop that a little?

A. The solution of a substance in another substance, as we understand it, is its mixing with that other substance in such a way that when you look at the two of them, they just look like one substance, and that means that the one substance, which we may call the solute, that is the thing that is put in the other, which we may call the solvent, is distributed around through the solvent in very minute particles. They may be of varying sizes, according to the particular solute or according

to the particular solvent, but they have got to be, of course, extremely minute so that you cannot see them. Now, when we say that a substance is in a state of chemical subdivision, we mean that it is broken up into the most minute particles, far beyond the range of the naked eye, far beyond the range of any microscope, or any microscope that has ever been thought of, and so when a man says that he has a substance in water in a state of chemical subdivision, there can be, of course, no other interpretation of those words than that it is dispersed as a solution.

THE COURT: We will adjourn until tomorrow morning at ten o'clock.

(Whereupon an adjournment was taken until tomorrow, Wednesday, June 27, 1923, at 10 o'clock a. m.)

THIRD DAY

Bangor, Me., June 27, 1923.

Trial Resumed.

Met pursuant to adjournment.

Parties present as before.

MR. DAVIS: Mr. Taggart, take the stand.

ARTHUR FAY TAGGART resumes the stand:

MR. DAVIS: If your Honor please, we were discussing yesterday the occurrence in this art, or the use in it of this physical force, the attraction of oil for mineral particles and the extent to which it had been used in various processes, and the wide range of agents that had been pointed out as usable. We had covered the patents, like the first one to Haynes, where the oil was kneaded with the ore and separated the mineral, and the processes like the so-called oil-rafting processes, where the oil was present in sufficient quantity to float the mineral by its own buoyancy, and then Professor Taggart referred to the two Bessel patents, which were air

or gas flotation processes, in which the mineral particles were lifted to the surface, either by boiling or by the release chemically of gas bubbles in the body of the ore pulp, and reference was made to the Cattermole process, which was not a flotation process, but in which the oil was present in not sufficient quantity to raft the particles, but in sufficient quantity to make them stick together and to form granules which were heavy enough to sink, and we now come to a patent which has been known as the Bubbles Patent, but before proceeding with that, I want by questioning the witness to correct an error in yesterday's testimony.

DIRECT EXAMINATION (Continued).

By MR. DAVIS:

Q. 9. Yesterday, Professor Taggart, in referring to the Cattermole, Sulman and Picard Patent No. 788,247, the so-called soap flotation patent—the page of the testimony is 192—you said that after the mixing or dissemination of the agent—and I quote:

> "The mineral particles which, following the precipitation of these substances, had become coated with them, were to be separated by granulation"

or by a floating process with gas bubbles. Is that a correct statement about this particular American patent?

A. No, the American patent describes only the flotation of the coated mineral particles by various means. The British equivalent of this patent 788,247, which is quoted further along in the same answer at page 193—British Patent No. 17,109 of 1903, covers the two methods, namely, granulation and flotation as the method of recovering the coated particles.

Q. 10. That is, the British patent combines in one the two American patents, 788,247 and 777,274, is that right?

A. Yes.

Q. 11. Now, will you please refer to the American patent to Sulman and Picard, No. 793,808 of July 4, 1905, and tell us what process of flotation is described in that patent?

A. This patent describes first the addition to a freely

flowing pulp of various kinds of oily substances having a preferential affinity for metalliferous matter over gangue, and then describes several different methods of separating the oiled substances from the gangue.

One of the methods is that of skin flotation, which is a method that was old at that time, and consisted in bringing oiled particles to the upper surface, that is, the air surface of the body of water. Under those circumstances the gangue particles which even in the presence of oily substances are quite readily wet by water become wetted and pass through the surface and sink, but the metalliferous particles, which have an apparent tendency even to repel water in the presence of air, which are certainly not readily wetted, refuse to pass through the surface and float by the force of surface tension at the surface of the liquid and then can be drawn off by overflowing the upper layer of the liquid.

There is also described in this patent one of the pulp body processes for floating the oiled mineral particles, namely, the chemical-generation process, and it is substantially that described in Froment.

Another means that is described is that of blowing air into the body of pulp through a perforated pipe, and there is illustrated in the patent an apparatus with a coiled perforated pipe in the bottom of a tank, a sloping-bottom tank, through which the air could be blown.

Concerning this particular method of operation the patentees say in the treatise at page 82—they had been discussing there some arguments that had been put forward in connection with the difficulties of getting gas generated chemically in a pulp and at the surfaces of the carbonate particles to attach to sulphide particles at a distance, and they had explained, as I stated yesterday the fact that the gas went into solution directly at the point where it was generating, and then precipitated, as the solution moved, on to the sulphide particles.

Then they said further, and following that:

> "This disposes of the difficulty previously felt as to the fixation of gases derived from material not in actual contact with the mineral to be floated."

In other words that it went into solution and was precipitated.

"Nevertheless in fairness to those who have expressed such difficulties it must be admitted that mineral flotation is difficult to achieve by simply passing a *current* of gas bubbles through the pulp."

In other words, they had had a lot of trouble with this particular method that they had described in this patent.

MR. GARRISON: If your Honor please, we do not wish to be understood as admitting the relevancy or materiality of competency of this treatise under any proper theory of law applicable to this case. We do not think it judicious to interfere with the examination of this witness by interposing objections. We reserve the right to move to strike out any reference to the treatise on grounds we will urge latter.

THE COURT: That is understood.

MR. DAVIS: I think perhaps that I ought to say; we proceeded yesterday on the understanding that the objections that were raised before the Master in the Miami case were printed in this deposition, as the objections were in the Bradford deposition. Now that is not so. So, at such time, if such a motion is made, it will be necessary to make a full argument here, and there is at least one other ground for admitting the thing in evidence here that did not exist in the Miami case.

THE COURT: That is, the treatise?

MR. DAVIS: The treatise. That ground arising out of our defense that the patentees themselves knew of the subject matter of the invention of the patent in the suit individually long before the date of the supposed invention.

Q. 12. Will you proceed, Professor Taggart?

A. There is also another method described in this patent, and that is to suspend volatile oils as a spray or a vapor in the gas that is introduced through the coil pipe—the perforated pipe, and then recover the mineral by flotation. This

particular process has subsequently been perfected and had considerable commercial use in this country in connection with the flotation of ores.

Q. 13. I have in my hand a copy of an article contributed to the proceedings of the Institution of Mining & Metallurgy of Great Britain, by H. Livingstone Sulman, and printed in 1919; you are familiar with that article?

A. Yes.

Q. 14. On page 4 of it, Mr. Sulman says:

> "In 1903, a patent was filed (foot-note, Sulman and Picard patent No. 20,419 of 1903) for separating mineral from an ore pulp by sending through it a current of air bubbles laden with the vapor or spray of oil. This method however did not lead to the production of a froth, nor to any practical result, as the other antecedent conditions essential for froth formation had not at that time been ascertained."

Q. Is the patent there referred to, the British equivalent of the American patent that you have just discussed?

A. Yes.

Q. 15. In this United States Patent No. 793,808, which you have discussed, the patentee says that his invention relates to the concentration of ores:

> "by separation of the metalliferous constituents and graphite, carbon, sulphur, and the like from the gangue by means of oils, grease, tar, or any similar substance which has a preferential affinity for metalliferous matter over gangue."

To what substances would that remark direct a man skilled in the art at that time, namely, 1904?

A. That would direct him to any of the substances that were known at that time to have this "preferential affinity" and that were known to the art through the many patents describing processes utilizing "preferential affinity." I think I referred yesterday to one of the Elmore patents, in which the wide knowledge of the art as to "preferential affinity," and as to the substances having it, was set forth. Patent No. 703,905, of 1902, where it said:

"I shall use the word 'oil' to mean either oil or any other substance that can exert a selective action on minerals such as oil exerts."

By Mr. Davis:

Q. 16. At a later part of the specification, the patentees of this United States Patent 793,808, say that they used "the vapor of a volatile oil, such as petroleum of low boiling point, or with the spray of any other suitable volatile or non-volatile or fixed oil or the like."

Does that expression indicate this same wide use of oils for flotation agents in that process?

A. Yes, the word "volatile oil" includes a well-known class of oils that are capable of being distilled without decomposition, and among those used are, for instance, the essential oils that were mentioned in the Bessel Patent No. 42 of 1877, that I referred to yesterday, and that are also referred to in the second Bessel patent. The term "fixed oils" also describes a very considerable class of oils, containing a considerable number of specific oily substances.

Q. 17. Will you now refer to the United States Patent to Elmore, No. 826,411 of July 17, 1906, and tell us what process of flotation is described in that patent?

A. This is another of the pulp-body concentration processes, the steps consisting in first making the freely flowing pulp with water, adding an oily substance and dispersing it through the pulp, and then subjecting this pulp to a vacuum. As soon as water which, in ordinary conditions such as it flows in streams and pipes around us here, contains about 2 per cent. by volume of air in solution in it, is subjected to a vacuum, a condition of super saturation of the water with air is brought about, and the gas—air—begins to precipitate out of solution. Now, always when precipitation takes place out of solution, it begins on the points and places that are most favorable for precipitation, and it had been abundantly demonstrated up to this time that the places most favorable for precipitation in the ore pulp were the surfaces of the sulphide particles. The gas then, upon subjection of this pulp to the vacuum, precipitates onto the sulphide

particles, and buoyant agglomerations of gas, and oiled sulphide particles are formed, that rise to the surface of the liquid in the apparatus and collect there in the form of a characteristic froth, and are overflowed, while the gangue particles remain submerged and are drawn off. A very ingenious apparatus for the commercial application of this process was developed and set forth in connection with it.

Q. 18. Is that the process that is known in the industry as the Elmore Vacuum process?

A. Yes.

Q. 19. Did it have any wide application in the industry?

A. A considerable application.

Q. 20. Have you any publication of a date earlier than January 1, 1908, in which this industrial use is referred to, and in which the agents employed are also referred to?

A. Yes, in the Mining Journal of London, which is a technical or trade paper of the mining and metallurgical industries, there appears at page 623 of the issue of May 11, 1907, a description entitled "The Vacuum Process for Concentration of Ores." In this article is shown a photograph of one of the commercial sized machines, and a line drawing of the apparatus, preceded by a tank for mixing the oily substance with the pulp, and showing the means of introducing the oiled pulp into the vacuum apparatus, and also tanks for the collection of concentrates and tailings. There is in this article a considerable description of this apparatus and its application. The results of various tests on a wide variety of ores are given, and incidentally these tests show remarkably good recoveries and grades of concentrate in many cases. There is also a statement of the agents employed, as follows:

> "The quantity of oil and acid required is not the same for all ores, but usually amounts to not more than a few pounds say, from 3 to 10 pounds per ton of ore treated.
>
> "A large variety of oils and similar substances have been tried and found suitable, such, for instance, as Californian crude oil, Texas crude oil, Texas residuum, fuel oil, Russian crude, Borneo, Sumatra and similar cheap oils, tars, blast furnace oils, olive oil residues, oleic acid, kerosene, a variety of light oils, and fish oils."

A similar article appears also in a publication in this country, the Engineering & Mining Journal of the same date, May 11, 1907, entitled "Vacuum Flotation Process for Concentration," and is stated to have been written by Alexander Stanley Elmore. The same statements and same results of tests are made in this article and the same list of oils and quantity of oils are expressed.

MR. DAVIS: Note that the first paper is Defendant's Exhibit No. 78, and the second one is Defendant's Exhibit No. 79.

Q. 21. What does the patent say about the agents to be used in this Elmore Vacuum process?

A. It states that substances suitable for bringing about the flotation are "an immiscible liquid, such as tar or oil, with soap or the like, or with an alkali, an acid, air, or a gas, or with any of the aforesaid substances in conjunction with each other."

Of course, the statement there that the gas is a flotation agent means that it should be used for levitation purposes, and it also has a kind of preferential affinity under certain circumstances, for instance, in which a mixture of gangue and mineral particles was brought to the surface of water and the mineral particles float. That is due, of course, to the tendency of air to prevent water from displacing it at the surface of sulphide particles and can, of course, be construed that there is a "preferential affinity" of the gas for the sulphide particles, but that is not what is ordinarily meant by the term "preferential affinity."

There is also mentioned further on in the same patent, oil or acid as the added substance in connection with the quantity of material that can be used to effect the flotation.

And in one of these publications, concerning the Elmore process—one that appeared in the Engineer, London, of May 10, 1907——

Q. 22. Exhibit No. 81.

A.—there is stated: "As a revolutionary improvement on the gravitation principle, and in some measure a reversal

of it, has come the process of concentration by means of oil. For some years the known affinity of oil for metal has caused inventors to conduct careful experiments in order to bring that property to bear upon pulped ore, and on more than one occasion we have referred in these columns to the progress of these researches."

There, of course, they were using the word "oil" as it was used in the art commonly at this time, as including all of these substances that had "preferential affinity," well known throughout the art.

Q. 23. Please refer to the United States Patent No. 835,120, of November 6, 1906, Defendant's Exhibit No. 54, and state what process of flotation was described in that patent.

MR. DAVIS: This is the patent, if your Honor please, that was involved in the prior litigation, the so-called first patent, or the agitation froth patent.

A. This patent represents another step in the development of pulp-body-concentration processes, in which agitation of the pulp by proper means is used to bring about the essential condition of super-saturation of the water of the pulp with a gas in the presence of oiled sulphide mineral particles. The steps of the process are, first, the production of a freely-flowing pulp, which is, of course, a familiar step in all of the processes. Second, the addition thereto and the incorporation therewith of an oily substance having "a preferential affinity for metalliferous matter over gangue." Third, agitation of that pulp of such intensity and of such duration as will cause gas to precipitate from solution onto the surface of the sulphide particles; and finally allowing these buoyant aggregates of gas and mineral particles to rise to the surface and there collect in the form of the familiar froth, which is removed from the submerged gangue.

It is not quite so easy to see at the first blush how the gas precipitation is effected in this process, because, as you see it in operation, even assuming that you go to the point of making an apparatus with glass sides so that you can observe what is going on in the pulp, nevertheless, there is such

extreme turbulence in there, and the particles are all moving with such rapidity, that it is very difficult to sort out what is happening. But it is quite apparent when you look in the spitzkasten of this machine—that is, in the chamber in which the rise of the froth is allowed to take place away from the violent agitation—you see immediately that the aggregates of gas and sulphide rise out of the mass of the pulp with their work of concentration complete. The bubbles are coated with sulphide mineral particles in preference to the gangue particles, and they have made this selection down in the body of the pulp. That immediately points us to the fact that we get the same kind of a result in this process as has been obtained in all of these other pulp-body processes, and from this it is natural to conclude that the selection has been made by gas precipitation in the body of the pulp.

It took quite a while to see, however, how the essential condition of super-saturation was brought about. Of course, most people are familiar with the fact that a ship's propeller, for instance, well submerged below the surface of the water, and operating, will cause bubbles of gas to stream off behind it. Now, the only place that those bubbles of gas can have come from is from solution in the water, and then if you begin to think with that in view, you immediately see, of course, that as these beaters move around in the body of the pulp in the agitation compartment at high speed, there is formed behind each one of these beater blades, a substantially complete vacuum, and of course the gas is going to precipitate out there precisely the same as it does in the Elmore Vacuum process, or whenever the pulp is subjected to a vacuum; and then, I think the process has one advantage, perhaps, over the Elmore Vacuum, because at the same time that you are producing a vacuum behind the blades of the impeller there is a marked increase in pressure above atmospheric pressure exerted on the pulp in front of the blades. The rotation of the rapidly-rotating stirrer in this agitation compartment draws down the surface of the pulp in the compartment in a V-shaped vortex with the point down, and that is drawn down until its tip reaches the beater blades near the

bottom of the compartment. There the tip is continually broken off and the big bubbles of air pass into the pulp and then these bubbles are immediately broken up by the beaters revolving at high speed, and extremely minute bubbles are formed, in a condition most suitable for solution in the pulp; because in all processes of solution, when we wish to cause rapid solution, we subdivide the material that it is desired to dissolve as finely as possible. So here these bubbles are disseminated very finely; they are in the zone of pulp directly before the beater blades; they are subjected to high pressure, and, of course, they go into solution because of the increase in pressure. Your Honor will understand that the solubility of a gas in a liquid increases with the pressure on the liquid; so that the increased pressure there will induce the solution of these finely-divided gas bubbles. Further there is also existing an impoverishment of the solution in gas, by reason of the vacua that have been created behind the blades with the consequent precipitation.

So that we see from the fact that the bubbles rise from the pulp with their work of concentration finished, indicating that we have here one of the pulp-body processes, and from the fact that all the other pulp-body processes involve precipitation of gas, and then from this little, and what was to me utterly accidental, lead of the ship's propeller, it is very easy to arrive at the explanation of the way in which the gas precipitation is effected. Having that lead I went ahead and checked out and actually measured the fact that there was a vacuum produced behind the impeller blades, and made the thing perfectly tight from the point of view of truth.

Q. 24. Is there any other process described in that patent of introducing the air into the body of the pulp?

A. On the second page of the patent, at line 102, there begins the description of what is called an alternative method for the recovery of any sunk oiled metalliferous matter which may be deposited in the second and third spitzkasten, that is, that fail to be floated in the first agitation in the chamber, and this method is to take that pulp and pump it into a container that originally contained air, so that the pulp was sub-

jected to an increased pressure above atmospheric in the presence of air. Now, under those circumstances, of course, more air will dissolve in the pulp than could dissolve at atmospheric pressure. That is, the utilization of this increased pressure in order to effect solution of the gas in the water, and then subsequently the release of this pressure, by discharge of the pulp into the atmosphere, and as a result, this releases the gas that was dissolved and it precipitates from solution preferentially on to the oiled sulphide particles and flotation is effected. The process is one that is nowhere near so satisfactory to work as any of these other pulp body processes that I have described. It is not easy to pump this stuff into a chamber and leave it there for a while, for the air to be dissolved in it, and then to discharge it, necessarily under high pressure, when it comes just spewing out of the discharge into a spitzkasten; it is more or less of an intermittent operation and not particularly satisfactory, but it more or less rounds out the processes of pulp body concentration. It is a variant of the Elmore, in that the Elmore reduces the pressure to effect precipitation, while this first raises it and then reduces it. The principle is the same as in the Elmore.

Q. 25. It is said to be a characteristic of this invention, is it not, that the flotation agent is used in small quantity, that is, in a fraction of one per cent on the ore?

A. Yes.

Q. 26. And the patentees say that the agents they propose to use are "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue." To what substances do those words refer?

A. The oils, as I have stated several times before, mean under the usage of the flotation art at this time, any one of the oily substances that is well known to have the "preferential affinity." Fatty acids have been previously mentioned. They are included in the phrase, under the broad interpretation that was then current in the art. They also include some substances that would not normally be referred to as oil. Such, for instance, as acetic acid, and formic acid and valeri-

anic acid, the lower members of the so-called fatty acid series. That is, fatty acids are organic compounds that contain what are known as hydro-carbons, or combinations of the hydrogen with carbon, and then also contain what is known as a carboxyl radical, if I may use the technical term, a combination of carbon, oxygen and hydrogen that is known as the acid-bearing part of these fatty acids. All of the fatty acids have this carboxyl radical. They have differing amounts of the hydro-carbons in them, and the series with its common carboxyl radical and increasing amounts of hydro-carbon is known as a homologous series or a series of homologues. Valerianic acid is one of the fatty acid series, and these other substances that I have named are other members. All of those are included in the term "fatty acids." "Other substances which have a preferential affinity for metalliferous matter over gangue" is a general term. If we cut out the other "other" in it, it, of course, includes the two others. I would consider it as a broad term placed there to point out and include all possible substances that have this "preferential affinity."

Q. 27. The patentees say on the first page, line 61, the following:

> "The proportion of mineral which floats in the form of froth varies considerably with different ores and with different oily substances, and before utilizing the facts above-mentioned in the concentration of any particular ore a simple preliminary test is necessary to determine which oily substance yields the proportion of froth or scum desired."

Is that statement in accordance with your experience?

A. It is an unfortunate circumstance that there has been no way discovered so far to short-cut the search for a successful flotation agent. There are, of course, a large number of ores that are amenable to froth-flotation concentration, but there are very few of them that will give the best result with the same flotation agent, so that every time, when a new ore comes to an investigator to treat, he has got to start in with some substance and observe what happens and usually,

if he is experienced, he can draw on that experience to add something more, or to try something else that will yield the result that the first test was lacking in. That carries him another step, but always there is this search, by trial and laborious trial in many cases, for the proper agent to use. So that this quotation is an absolutely correct statement of the thing that has got to be done in order to determine what is the proper substance and what is the proper proportion for use.

THE COURT: After it is done one time, it is done for all time?

THE WITNESS: That is what we would like to believe. For any given definite ore that is true; but, nevertheless, as the mill runs along, and the ore comes to it first from one part of the mine and then from some other part of the mine, you might find some morning suddenly that things have gone all to pieces; and this trial has got to be started again. Of course, it is not very often that the whole concentration is lost. The results fall off somewhat, and there has to be a search for some other reagent, or perhaps it may be necessary to change some other conditions in the treatment; but as a general statement you can say that when you have found the substance for a given ore, you have something that can be stuck to pretty closely as long as that ore is being treated. There is always, of course, the search for something that is cheaper going on, because concentration is not just a scientific operation, but something that you want to make money out of.

Q. 28. Has it resulted from this, Professor Taggart, that in this agitation froth process a great variety of oils has come to be used with different ores?

A. Yes.

Q. 29. Have those oils all been one class; that is, all mineral oils, or all vegetable oils, or all animal oils, or have they been of the different classes?

A. They have been of many different classes. That is quite apparent from the patents and the very wide number of classes that has been listed in those.

MR. DAVIS: I may interject the remark here that this is the patent that was so much litigated, and the opinions of the various courts will show to your Honor that all sorts of oils and mixtures of oils were used in it.

Q. 30. Professor Taggart, I will refer again to this patent, 835,120. In the paragraph beginning in line 16, there is a reference to this Cattermole granulation, patent No. 777,273. Does that constitute any further reference to the oils or oily substances which are appropriate for use in this process?

MR. GARRISON: Is not that a question of law, if your Honor please?

MR. DAVIS: Perhaps the form of my question is unfortunate.

THE COURT: It would seem to be a question of law, the way you put it.

MR. DAVIS: Perhaps I ought to re-phrase the question.

Q. 31. The patent No. 835,120 refers to the Cattermole patent No. 777,273. What oils and oily substances were indicated as suitable in the patent No. 777,273?

MR. GARRISON: Has not he already given us that? I thought it was on the record once.

MR. DAVIS: Just as briefly as you can. I guess it has been covered before.

A. The direction there is to use oils and certain particular products or similar compounds "all hereinafter referred to as oil" and that of course is a general reference back to the large number of oils and oily substances comprised in the knowledge of the art under this particular phrase. They state further on that a fatty acid may be used as well as mineral acid for acidulating the ore-pulp, which means that a fatty acid, which also has this preferential affinity, may be mixed with any of the other substances above mentioned. And then there is a list of specific oils given on page 2, beginning at 89, a definition of the word "oil" as they had previously used it and understood it, that covers everything in the way of an oily substance, as far as one can see, in nature

There are mentioned there coal and wood-tar products specifically which have had a strong hold in flotation practice since that time.

Q. 32. And does the reference to the Cattermole Patent No. 777,274 add any specific oils; I mean by that, does it mention by name any individual oils or oily substances that are not named in the patent No. 777,273?

A. It names specifically oily substances that are not specifically named in No. 777,273, but it does not name anything that is not included within the description, the general broad description of 777,273. There are, for instance, resin acids that, to my recollection, are not mentioned specifically in patent 777,273, and there are also phenol and cresol that are not mentioned specifically in the earlier patent; but phenol and cresol are included under the general term "coal and wood-tar products," in the earlier patent, and the resin acids are included under the general term "vegetable oil" in the earlier patent.

Q. 33. I call your attention to the United States Patent No. 835,479, which is said in the specification to be a division of the patent application which resulted in the patent No. 835,120. Is this patent No. 835,479 a patent for that "plus-pressure process" that is indicated in patent No. 835,120 and which you have already described?

A. Yes.

Q. 34. And it proposes to use for an agent "oil or other suitable substance having preferential affinity for metalliferous minerals;" that is, column 1, line 43, of Defendant's Exhibit No. 60?

A. Yes.

Q. 35. Now, will you take the patent to Sulman of November 6, 1906, No. 835,143, Defendant's Exhibit No. 59, and state as briefly as you can, what process of flotation is described there, and what agents are indicated?

A. This is a process of the pulp-body type, in which the same method that was utilized by Bessel in the German patent of 1877, namely, boiling, is used for the purpose of causing the generation of gas in the pulp. It mentions metalliferous matter and graphite. It differs from the Bessel patent in that in this patent the freely-flowing pulp is made before

the admixture of oil, and that in the Bessel patent the oil is added to the dry ore and then the mixture is put into water; and it differs also from the Bessel patent in that acid is prescribed, as being used, while the use of acid was not known, at least its advantage was not known, at the time of Bessels. It differs on those two scores. The oily substances that are to be used are stated to be "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue," and oleic acid is mentioned as a specific substance, as a specific fatty acid that is particularly applicable. They are the substances, of course, that are suitable here, the same ones that were suitable in Bessel. There was no necessity particularly for Sulman at this time to go into detail with regard to re-agents as Bessel did, because Sulman was late in the field by comparison, and all these substances were well known in the art, so he could use the generally descriptive term to include all of them.

Q. 36. You have already told us how the mill man has to go about determining for a particular ore what particular oil or oils are suitable. Are there other considerations which would determine his selection, other than the mere question whether a mineral-bearing froth was produced or not?

A. Yes. The first thing, of course, that he has to consider, is how much the stuff costs, and by that particular criterion he scratches out a very large number of the substances that are generally listed as oils and oily substances; and then, of course, having satisfied himself on that score, he will start in testing.

Mr. Davis: Now, if your Honor please, that is a somewhat prolonged recital of these patents, which has been put in for the purpose of showing that we can, in this art of flotation generally, use these various processes, and there was indicated a wide choice of oils and oily substances, and that that choice was restricted, of course, by economic considerations. I proceed now to consider the question of the solubility of those substances as they were used in these processes, and when

I say that, I mean solubility in the proportions of water that are present in these processes, because solubility depends upon the amount of water present.

Q. 37. Professor Taggart, is it possible to arrange all of these oils and oily substances, that is, all of these organic mineral-frothing substances, in two separate lists, without duplication, I mean, one list containing only soluble organic substances and the other containing only insoluble organic substances?

A. Yes, it is possible to do that, provided that the terms are defined.

By The Court:

Q. 38. There were some partly so?

A. Yes, sir; also the word "insoluble" is such an indefinite term. For instance, the chemists in making their refined measurements considered glass soluble. Now, we do not ordinarily think of glass as soluble, and glass certainly would not be considered soluble for the purposes of flotation. So that if we define insoluble as meaning that condition in which no sensible portion of the substance considered disperses through water, as I stated yesterday, and makes a mixture that is just one, in so far as eyesight——

Q. 39. You mean perceptible to the eye—so far as perceptible to the eye?

A. Yes.

Q. 40. Do you limit solubility to perception to the eye?

A. I think we have got to take some such practical limit for our work here. If we attempt to use a rigid definition of solubility we really cannot get any place, because everything in nature is soluble to some extent, probably in everything else, certainly in water, so that if we take that we cannot get anywhere. Then the tests for solubility—physical tests for very minute solubility—are most refined tests that no mill man could be expected to make at all, so that we have got to take some common sense, every-day definition of the term. Now, Szigmondy, who is a well-known physical chemist, in one of his books, discusses the whole question of solution

and says that unless we do take some such practical definition, every time that somebody invents a microscope that we can see a little bit smaller things with, we have got to move down the definition of solubility. We cannot do that, and again we are coming into these refined physical measurements, so that it seems to me that for practical use in flotation processes, the proper thing to do is to take the every-day common-sense understanding of the word "solution," namely, the production of a mixture that looks just like water, or at least is clear—it may be colored by the thing that goes in it, but you cannot see any particles in it as you look through it, you cannot see any evidence of suspended particles. There is, in other words, a merging of the two substances.

Q. 41. And your definition is that an element is soluble where it is divided into such small particles in the solution that it cannot be perceived by the eye?

A. Yes, sir. Now, if we take that for the definition of solubility, and if we designate as insoluble for flotation purposes a substance that does not to any sensible extent go into solution in water, when it is mixed with water in the proportions in which it is used in the flotation operation, then I would say yes to your question, you can make up a list of oily substances or organic substances that are soluble, and another list of those that are insoluble.

By Mr. Davis:

Q. 42. Well, as I understand it, you mean substances which, when mixed with water at ordinary temperature in the proportions in which they are used in the flotation art, would disperse themselves in the water to make what is called a water-clear solution?

A. Either partially or completely, yes.

By The Court:

Q. 43. You limit it, then, to the proportions used in the water?

A. That I think you have got to do, for the reason that the extent to which a substance dissolves in water depends upon the relative proportions of water and oil present.

By Mr. Davis:

Q. 44. Well, that can be compared, perhaps, to make it clear, to the fact you just spoke about, that if you have a microscope of increased resolving power, you can see more with it, and if you have water of increased amounts at the same temperature, you can dissolve more with it?

A. Dissolve more out of a given amount.

By The Court:

Q. 45. Then solubility really is a relative term?

A. Distinctly so.

By Mr. Davis:

Q. 46. Now, having made up those two lists of insoluble and soluble organic substances with that definition, in which of the lists would you find those substances which have shown themselves to be organic mineral-frothing agents?

A. Always and without exception in the soluble list.

Q. 47. That is, unless the substance is in some proportion either wholly or partially soluble in the water used in the process, you say that it has not been usable in practice as a mineral-frothing agent?

A. That is true.

Q. 48. Does that apply to all of these processes you have described?

A. Yes, it applies in different degrees with different of the processes. In the Elmore Vacuum process it is possible to get along with an oil that is less soluble than it is possible to get along with in the agitation froth process, for instance, but even with that difference the answer to your question is yes.

Q. 49. In the article by H. Livingstone Sulman, published in 1919, and entitled "A Contribution to the Study of Flotation," on page 5, I find the following statement:

Mr. Garrison: When was this published?

Mr. Davis: 1919.

Q. 49. (continued) "The essentials of froth-flotation are that an aqueous ore-pulp, in general not less than four parts by weight of water to one of ore, shall be agitated for a longer

or shorter period with certain reagents, which may conveniently be classified as follows:

"(a) A *'froth-producing'* material, e. g., cresol, amyl alcohol, the soluble portion of an oil, etc.;"—

MR. GARRISON: Is there any question?

MR. DAVIS: Just a minute.

MR. GARRISON: Before you answer, Professor, I want to interpose an objection.

Q. 49. (continued) And on page 60, he develops that thought as follows:

"Thus, amyl alcohol in low concentration in an ore-pulp, e. g., from 1 part in 5000 to 1 in 20,000 or from ½ to 2 lbs. in a pulp consisting of 1 ton of ore and 4 tons of water, has been extensively used as a frothing agent, though later superseded by cresol in like or slightly larger proportions. The water-soluble portion of several fixed and many essential oils answers the same purpose. Since a minute amount of an insoluble oil adsorbed at the mineral surfaces will decrease their adhesion for water, a single oil may act both as a frothing agent and in enhancing the flotability of metal sulphides.

"If an oil, alone, be used, it must be such as will yield a sufficiency of aqueous solute; eucalyptus, pine-oils, turpentine, the terpenes and their hydroxy-compounds, camphor-oils, and a host of other compounds and derivatives both aliphatic and aromatic, conform to this requirement."

And on page 62 he says:

"Whilst for flotation purposes completely insoluble oils are unsatisfactory alone——"

Do you agree that completely insoluble oils are unsatisfactory alone?

MR. GARRISON: If your Honor please, I object to the reading from the document. We do not see how any statement made by Sulman in 1919 can reflect upon what he parted with in 1906. He is reading from a document. I suppose it is in evidence, is it?

MR. DAVIS: No.

MR. GARRISON: He is reading from a document not in evidence, and I object to it on that ground.

THE COURT: I cannot see why he cannot read an alleged scientific statement and ask him if he agrees with it.

MR. GARRISON: Your Honor has put your finger on it. It is "alleged." We are not bound by what Mr. Sulman says as an alleged scientist.

THE COURT: He reads from the document and asks for the witness' view on that.

MR. GARRISON: He can ask for his view equally well without reading this. The only purpose in reading this, of course, is to indicate that Mr. Sulman, one of the patentees, who parted with his title in 1906, has said something that is satisfactory to Mr. Davis in 1919.

THE COURT: That may be so. That may be one of the arts of the trial; I am not familiar with that.

MR. GARRISON: That is an art familiar to all trials.

MR. DAVIS: I should do less than my duty to the Court if I did not say that I could not expect to get away with that during a trial. I do not expect your Honor to be misled so easily as that. It is a statement in a well-recognized scientific publication by a man of the highest standing in the art, and I ask this witness if he agrees with it.

THE COURT: He may answer.

A. Yes.

Q. 50. Now, Professor Taggart, if you had an ore which you were trying to float, and the agents that you had immediately at hand would not give satisfactory commercial results, where would you look for other agents?

A. I would first review the literature and such abstracts as I might have of the literature of the flotation art that dealt with oils that had been used, and after satisfying myself as to their availability from an economical point of view, would try to get hold of them and try them out. If I could not find the solution of my problem there, I would, I think, go next

into the literature of the oils and organic substances and the industries connected therewith, and if I could find a list that had the prices written down along with the substances I would start with that, and looking at the right hand side of the sheet first for the price, come down to and pick out a list of substances there that I had not previously tried; get hold of those and try them out.

Q. 51. Now, if in prosecuting such a search you found it stated either in these commercial lists or in hand-books that the substance that had attracted your attention was either soluble or insoluble, would that statement be of any assistance to you in your investigation?

A. No, it would not, because the question of solubility or insolubility depends upon the particular use to which the substance is to be put, and the books are horribly contradictory on that score, if you just take the plain words. I ran into a rather interesting illustration of that in connection with some of the fatty acids.

In the Van Nostrand Chemical Annual, which has run through several issues—this particular one that I have in my hand is the issue of 1918—oleic acid, in line 28, at page 342, is stated to be insoluble, and valerianic acid is another one.

BY THE COURT:

Q. 52. Let me interrupt you right there. That is said to be insoluble. Your statement is always governed by the quantity?

A. Yes sir, precisely. It says "solubility in 100 C. C.," namely, 100 cubic centimeters of water.

THE COURT: Now this patent which was sustained by the Supreme Court, and was much litigated, was sustained on the ground that the quantity of oil was less than 1 per cent. Would you call that quantity soluble or insoluble, 1 per cent or less?

MR. GARRISON: Of oleic acid?

THE COURT: Of oleic acid, yes.

THE WITNESS: You see, the 1 per cent on the ore would be 20 pounds of oleic acid per ton of ore. Then using four parts of water by weight per ton of ore, in

order to make the freely-flowing pulp, it would be, instead of 1 part in a hundred, 1 part in 400 there.

Now, under those circumstances if the oleic acid produced flotation, it would most certainly be soluble to some extent, because you cannot get froth flotation unless there is present a soluble constituent; so that would be my first evidence that it was soluble. Then, if I tested it, by stirring it up, for instance, in water, in the proportions in which it was used, namely 1 part in 400 and stirring it with the same degree of violence with which it was stirred in use, and then filtered off the water from the oleic acid that would remain undissolved—and there would undoubtedly be a very considerable proportion so remaining—I would find in the filtrate, the clear filtrate, oleic acid, which could be tested by several different methods. For instance, you can taste it, and you would find that it tasted of oleic acid; smell it, and it would smell of oleic acid; or by chemical methods, the oleic acid that is present in there can be recovered and weighed, and the proportion of it with respect to the original oleic acid determined.

Now, oleic acid is very rarely used in such large proportions as you have mentioned, your Honor. The 1 per cent. is the upper limit. If you go down to 1 or 2 pounds per ton of ore, which is the usual proportion there, I have made actual quantitative determinations of the amount in which oleic acid dissolves, and found that it was quite a sensible amount. I have forgotten just the particular figures, but as I recollect, somewhere between 6 and 10 per cent, dissolved in those proportions.

Q. 53. Suppose you added phenol or cresol in those same proportions, what would be the solubility?

A. If the phenol and cresol that were used were pure substances, phenol would go completely into solution. The cresol would also, if it were pure—but it is so extremely difficult to get it pure that I have never been able to get it all to go into solution. It goes very nearly all of it into solution under those circumstances.

Q. 54. And is it true, Professor Taggart, with all of the mineral-frothing agents that have ever been used in any of

these processes, that they are all soluble in some proportion, and some of them are wholly soluble in the pulp?

A. Yes. They are all soluble in some proportion, and some of them wholly soluble.

Q. 55. You understand that I had in mind in my question both the mixtures, that is, the prepared mixtures, as where you add pine oil to a petroleum oil, as well as the compounds and the individual substances?

A. Yes. The reason that I hesitated there was that I thought that your question had said that all of them were completely soluble in some proportions. That is, that if you have used a small enough amount of it with respect to the water, that in every case it would all go into solution. That is not the case unless the definition of solubility is strained considerably, that is, to the point where, for instance, we say that glass is soluble. If we went to that point, then that latter statement might be true, but that I do not think, is a proper length to go.

Q. 56. If I understand what you mean, Professor, it is this: That they have sometimes used a prepared mixture of which one constituent would be practically insoluble, that is, insoluble within the definition that you have adopted, and added to it a second constituent which introduced into the agent as a whole that necessary soluble constituent which Mr. Sulman said was necessary?

A. That is quite true, and there are many of the naturally-occurring agents which are of that class also.

By the Court:

Q. 57. When a scientific man like yourself uses it, he must accompany it by his definition, otherwise the term is valueless?

A. That is quite true, sir.

Mr. Davis: I think there is no misunderstanding about that. We were speaking of solubility in the proportions in which these substances are used as flotation agents.

The Court: Yes. He governed his definition by that.

MR. GARRISON: It was not in this one question as to whether all these substances were soluble.

THE COURT: Perhaps not the last time.

THE WITNESS: That is understood of course throughout.

MR. WILLIAMS: And, Mr. Davis, to make it clear, you meant proportions in which they are used in the art today, or do you mean the proportions in which they are disclosed in these various patents, the whole list of which you have put forward. Of course you mean the art today, don't you?

MR. DAVIS: I understood Professor Taggart to mean, in fact he said in answer to my question, that that was true of all organic mineral-frothing agents that have ever been used in practice in any of these processes.

MR. WILLIAMS: In practice?

MR. DAVIS: Yes.

MR. WILLIAMS: All right.

By MR. DAVIS:

Q. 58. Now, how about the solubility of pine oil? I ask that because that is an agent that is mentioned in the litigation and has been widely used.

THE COURT: Did you say pine oil?

MR. DAVIS: Pine oil.

A. Pine oil is not a definite fixed substance. That is to say, the pine oil that is bought from one manufacturer may be quite a different substance from that that is bought from another. It may have the same general characteristics, but it is in every case a mixture of a lot of different chemical compounds, and the proportions in which those occur depend upon the particular species of pine tree from which the oil is made, upon the particular temperatures and character of apparatus, etc., in which the oil is extracted from the tree; so that there are several different figures that I happen to have here for the solubility of pine oil when it is mixed with water, in the proportion of 1 part of pine oil to 4,000 of water. A pine oil, for instance, that was sent to me from the Miami

Copper Company contained 78.8 per cent of soluble material in those proportions. Another sample that was sent to me from the Nevada Consolidated Copper Company, and that was a mixture of two products put out by the Pensacola Tar & Turpentine Company, numbered by them 52 and 80, gave 40.4 per cent. of soluble material. Another sample that came from the General Naval Stores Company and was labeled G. N. S. No. 5, gave 69.2 soluble.

MR. DAVIS: Your Honor, I have introduced that question into the record, because pine oil is one of the oils which the Supreme Court in the Butte case specifically found to be an oil of the first patent. In fact, it was the representation of the plaintiffs there that the pine oil in the mixture was the only oil that was the oil of the patent.

Q. 59. Now, Professor Taggart, will you please give us a list of the principal oils and oily substances which have risen to the surface out of these great classes, as practical commercial flotation agents?

MR. GARRISON: As of what period is this, Mr. Davis?

MR. DAVIS: Well, I will have to get the list first, and then I am going to bring out the period.

A. Coal-tar and various coal-tar products and derivatives, including creosotes, and crude cresol, essential oils, including particularly pine-oil and eucalyptus oil; various petroleums and petroleum derivatives, oleic acid, crude phenol, rosin oil, blast furnace oil, tars in general. This word "tar" is an extremely broad term and includes tars made from coal, wood, peat and petroleum, and of course all of those substances have been used successfully and widely in flotation practice. Tar oils and tar products are broad terms, under which come many specifically named substances, mostly with trade names. Turpentine, and specifically again wood-tar and wood-tar products.

MR. DAVIS: Now, I can go on, if Judge Garrison wants me to, to have the witness point out where each of these substances was mentioned in particular patents that he has already discussed.

MR. GARRISON: That was not the point. These, you

said, were practical commercially. I do not care to have anything of that.

MR. DAVIS: Very well. My thought was that we can do that in briefs.

THE COURT: He suggested, as I understood, that you did not specify the periods in which these had risen to the surface.

MR. GARRISON: That is what I asked. I did not understand you meant anything about a patent. I thought you were talking about particular commercial flotation agents.

Q. 60. Can you give us some idea of the dates when these various substances had been used as practical commercial flotation agents?

A. Their use, I think, all of them, certainly most of them, has been coincident with all practices of froth flotation, so that wherever froth flotation has been used, these substances, one or more of them, have been used. Specifically, for instance, blast furnace oil is mentioned in this article that I read and quoted from this morning as having been used prior to 1907 in the Elmore Vacuum process. Similarly, tars and oleic acid, I believe, had quite a use (I am talking really now more from the literature and from general knowledge, than from my own knowledge) in Australia. I know of no highly successful use of oleic acid in this country. The tars and tar products in general have been widely used in connection with the agitation-froth process. That includes crude phenol and crude cresol, and those tar products have almost always, I should think, been used whenever the agitation-froth process has been practiced successfully. Essential oils and particularly pine oil have been very widely used in connection with the practice of the agitation-froth process.

MR. DAVIS: I am going to leave it with that, if your Honor please, because in my opinion the question when they were used in commerce is not important, if it appears that they were known substances; particularly oil which was known to have this preferential affinity might not have been in commerce until a late date, because a

particular ore to which it was particularly useful had not turned up.

Q. 61. Now, Professor, will you look at the patent in suit, please, and tell us what, if any, new flotation process—and I use that word as differentiating from new flotation agent—is described in the specification? The description of the process there begins with line 15 and runs down through line 78, of page 1.

A. I can find no new process described in that specification. It starts out with a statement that the crushed ore is to be mixed with water, that is, that there is to be made a freely-flowing pulp; that water shall have the agent in solution and shall contain also sulphuric acid. Then the mixture is to be thoroughly agitated, and then, following the agitating phrase and set off from it in a way that I must confess is somewhat confusing to me, is a phrase that on the face of it describes the method of introducing gas into the mixture. It states that the gas shall be "liberated in, generated in, or effectively introduced into, the mixture." Certainly, on a broad interpretation, those words would include all of the pulp-body concentration processes that were known to the patentees, namely, the boiling, or Froment chemical-generation, or the agitation-froth, or the vacuum, or any of the others. On the other hand those same three terms are correctly descriptive of what takes place in the agitation-froth process alone, and could be quite properly interpreted to be different ways of stating the precipitation of gas from the saturated solution——

THE COURT: What is your interpretation of the word "gas," including air?

THE WITNESS: Including air, yes sir.

A. (Continuing)—from the liquid in the agitation froth process, because the gas is certainly liberated in the agitation froth process by reason of the reduction in pressure behind the beater arms, as there is a release of pressure that liberates or frees the gas from solution, or it is generated in the sense of generation as a production of the thing by chemical or physical or mechanical processes. "Effectively introduced"

of course is a term that has no specific meaning, but means that the gas shall be so got in that it will act effectively, and in the treatise Sulman mentioned the different ways in which they were able to generate or effectively liberate—which was an effective introduction of gas—and has said that the method of generation by means of the rapid rotary stirrers was the same thing, and they got the same result as this other method, so that in that particular case there is the possibility of interpreting that phrase either so broadly as to include all of the pulp-body processes, or narrowly, to include only the agitation froth process, but in neither case is a new process of operating indicated. Then following the agitation and gasification comes the formation of the froth and the separation of that froth by various well-known means. The particular example of carrying on the process that is described beginning at the bottom of the first column of the page, is the agitation-froth process. It is carried out in an apparatus that is somewhat different from the one that is illustrated in connection with patent No. 835,120 and an apparatus that involved a material advance in the practical application of the agitation froth art, but it does not, it is stated, form any part of the invention in this patent.

Q. 62. Does the statement that the organic mineral-frothing agent is present there in solution differentiate it from these processes that have gone before?

A. Not at all. The organic mineral-frothing agent has always had to be present in solution, and has always been present in solution, whenever a froth was made by any of the pulp-body processes, or specifically by the agitation-froth process.

Q. 63. You mean that the organic mineral-frothing agent has always been present, either wholly or partially in solution?

A. Yes.

Q. 64. Well, if this specification is read to mean, when it says "in solution," an agent which is wholly in solution, does that differentiate it from the earlier patents or publications or practices?

A. No, I do not see that it does at all, because in the agi-

tation-froth process, patent No. 835,120, there is specified "oils, fatty acids or other substances which have a 'preferential affinity for metalliferous matter over gangue,'" and among those such substances that were well known in the art are one at least that I have specifically tested the solubility of, namely, phenol, and know that in the proportions that are specified in the patent No. 835,120 that was completely in solution. Amyl alcohol is another substance whose solubility I have not tested myself, but it is the largest constituent of fusel oil, and the least soluble of the constituents of fusel oil, and is also one of the substances that was available to the mill man under this patent No. 835,120, and certainly from the book figures on solubility of the various constituents of fusel oil, that was completely in solution whenever it was used in this process in the proper proportion."

THE COURT: Patent No. 835,120 is the litigated patent?

MR. GARRISON: Yes, sir.

MR. DAVIS: Yes, sir.

THE COURT: Previously litigated?

MR. GARRISON: Previously litigated.

By THE COURT:

Q. 65. Let me ask you, in this patent No. 835,120, where along the line was the organic matter introduced, where along the line of the flow?

A. According to the description of the application of the process, beginning at line 70 on the first page, the oily substance was added subsequent to the formation of the freely-flowing pulp and subsequent to the addition of a mineral acid.

MR. DAVIS: And before the agitation.

A. (Continuing) And before the agitation. In the description of the apparatus, at page 2, beginning at line 50, is described simultaneous addition if desired of ore and acid and water and the oily substances to the mixer. In the practice of these processes, of course, the general thing to do is to grind the ore in water so that the freely-flowing pulp is the first thing made. Then the re-agents may be added in some

cases during the grinding, in some cases after the grinding, but generally always subsequent to the admixture of ore and water.

By THE COURT:

Q. 66. Now, this patent in suit is as follows: "Water containing a small percentage," and so forth, and "containing in solution a small quantity, say, 1/10 of one per cent. of" "organic matter." That indicates that the water is impregnated with that before it comes in contact with the ore?

A. Yes, sir; and I think in the narrow reading of the patent and of the description, necessarily, that that would be the situation.

By MR. DAVIS:

Q. 66-a. That is not the case, however, in the defendant's practice?

A. No.

MR. DAVIS: If your Honor is in any uncertainty about that, I think that both sides will agree that in practice the organic mineral-frothing agent was added always before or during the agitation, and usually after the admixture of water with the ore, but sometimes in the grinding machines where the ore was admixed with the water.

THE COURT: What process are you referring to?

MR. DAVIS: That is the practice of the process of the patent No. 835,120.

Q. 67. Now, Professor Taggart, we interrupted you in reference to some text books on the question of what text books mean when they say soluble A. I had proceeded, I think, with the answer to the statement that at page 342, line 28 of the Van Nostrand annual, oleic acid is stated to be insoluble in water.

By THE COURT:

Q. 68. You mean one part in 4,000?

A. No, sir, meaning parts per hundred.

Q. 69. One part to a hundred?

A. No, it is not quite that. The test for solution may

be made by any one of a number of different methods, and really in quite a few different proportions, and then results reduced, as it were, to parts per hundred. There is no one method that has been applied to the making of these solubility tests. They have been compiled from the literature and are of utterly differing reliability, according to the man who made them and the method that he used. So that if you want to place any dependence upon them, practically the only thing you can do is to write to Olsen, the compiler of the book, and ask him who made the solubility determination, and how he made it, and what the original reference was, and then get back to that in the literature. So that you cannot place too much dependence on it, and you cannot say what method was used just from the book here.

By Mr. Davis:

Q. 70. Does that mean that for the practical flotation engineer the statement of solubility in the ordinary handbooks is useless?

A. Absolutely so.

Q. 71. You may proceed.

A. At page 374, line 25, valeric acid, which means valerianic acid—that is, either name may be used—and which is one of the lower members of the fatty acid series, is stated to be 3.7 parts soluble in water at a temperature of 16 degrees, the temperature being of importance in solubility.

By The Court:

Q. 72. Another element of uncertainty.

A. Yes sir.

By Mr. Williams:

Q. 73. That is 16 degrees C.?

A. 16 degrees C.

The Court: That solubility will mean nothing to me by and by.

Mr. Davis: That is just about what it means to the mill man.

The Witness: Now, this is another book, called a

Condensed Chemical Dictionary that is issued by the Chemical Catalogue Company, Inc., of New York City, and gives a lot of valuable information regarding the derivation and usage of various chemical substances, the grades that are available, the kind of containers that they may be shipped in, their uses, the question of fire hazard in connection with them, and railroad shipping regulations. In other words, a book that is very valuable to a man who is buying chemicals. On the subject of oleic acid, this book says at page 35: "A yellowish oily liquid, soluble in alcohol and ether, slightly soluble in water," as against the Van Nostrand insoluble. Then with respect to valerianic acid or valeric acid, it says: "Transparent, colorless, oily liquid, exceedingly disagreeable, rancid odor, bitter, burning taste, soluble in alcohol and ether, insoluble in water." So that it depends more or less on the book what you get out of the books, and the only thing to do in case the question of the solubility or insolubility of the substance becomes important is to test it yourself.

By Mr. Davis:

Q. 74. Do you recognize the type of apparatus illustrated in the drawings of the patent in suit, and with respect to which the patent says the apparatus itself forms no part of this invention? That is, can you identify that as having originated somewhere else?

A. Yes, I believe that I can. It is described, I think, in a patent to Hoover, No. 953,746, issued April 5, 1910. The apparatus illustrated in both patents is the same thing.

Mr. Davis: Up to this point, if your Honor please, we have been attacking the patentability of the thing claimed, that is the soluble agent, broadly. I proceed to show to what extent the specific agents mentioned in the patent had been used in the prior art or disclosed there. I do that despite the fact that the defendant's specific agent is not any one of those agents, and I do not understand that it is claimed to be.

MR. WILLIAMS: Not one of the agents named in the patent, no.

Q. 75. Professor Taggart, the first specific agent or class of agents named in the patent in suit is "amyl acetate and other esters." Will you tell us briefly what that phrase means and point out, if you can, where it had been proposed as a mineral-frothing agent in the prior art?

A. Amyl acetate is a colorless oily liquid that is called—an ethereal salt or ester. It corresponds to what are called salts among inorganic compounds, and, if I may interject here, the distinction between organic and inorganic substances is solely that organic substances contain the chemical element, carbon, and that inorganic substances do not. We are much more familiar in everyday life with inorganic salts than we are with the organic salts. For instance, our common salt, sodium chloride, is one, and epsom salts and various other magnesium salts, so called, are typical examples. Now, those substances are formed in the inorganic kingdom by the chemical interaction of substances that are known as acids, which have in general a sour taste and contain hydrogen ions, and substances known as bases, which contain a group called chemically the OH group, or hydroxyl group, consisting of oxygen and hydrogen linked together in such a way that the two act as one thing in chemical reactions. In similar organic reactions, an alcohol replaces the base and an organic acid is the equivalent of the inorganic acid. Those two react together chemically and form a substance called an ester, and they also at the same time form water. Amyl acetate is a particular one of the esters and, as I said, is a colorless oily liquid. It is known in the oil trade as banana oil and is one of the substances that is used in making lacquers and varnishes, and so forth. It is given its name because of the distinct odor of bananas that it has when not smelled in too great concentration. It, of course, is one of the wide classes of oils and oily substances that are specified throughout the various froth-flotation patents, and therefore well known as oils, at least to the art.

Q. 76. Now, can you refer to specific places in the prior

patents or literature where either the group of esters or amyl acetate, as such, is referred to?

THE COURT: Those patents are all in?

MR. DAVIS: Yes.

THE COURT: Why can you not point that out later?

MR. DAVIS: I can. That is a matter of identification.

MR. WILLIAMS: If the answer is to be "No" that would settle the matter.

THE COURT: He said "Yes", I think.

THE WITNESS: I did not answer yet.

MR. DAVIS: He would have to look up his papers. I will withdraw it. I can point that out some other time. Mr. Neary suggests that there may be some question of construction on account of the terms that are used, and, if your Honor pleases, I will let that question go until after lunch.

MR. GARRISON: We will have an answer. We would like to have that answered.

Q. 77. Now, Professor Taggart, if you take this banana oil in a fraction of 1 per cent or less on an ore, add it to the ore pulp, and vigorously agitate it in a machine such as is shown in the patent No. 835,120, or such machine as is shown in the patent in suit, will there result from that agitation with that percentage of banana oil a tendency for the metalliferous matter to rise to the surface of the pulp in the form of a froth or scum?

A. Yes.

Q. 78. Will the metalliferous matter be found to be coated with banana oil?

A. It will be coated with banana oil. It will take more than just looking at it to determine that.

Q. 79. And in that operation will the banana oil be present in the pulp in the solution or not?

A. Yes.

Q. 80. Wholly in solution?

A. In so far as published figures of solubility are concerned, I have not tested banana oil in those proportions myself.

By The Court:

Q. 81. How do you tell about the solubility where your element is not clear in the water?

A. Ordinarily if there is not solution, the water will be clouded. The light in passing through is bent more or less as it passes from the water into the other substance and then bent as it comes out, and you get a cloudy effect instead of a clear effect.

By Mr. Davis:

Q. 82. The next agent specifically mentioned in the patent in suit is phenol and its homologues; what does that mean?

A. Phenol is one of a series of substances, such as the fatty acid series you will remember that I spoke of, that is composed of hydrocarbons, with, in this particular case, an OH radical. The chemical composition is given as C_6H_5OH, indicating that there are six atoms of carbon, five of hydrogen, forming the hydrocarbon part of the material, and then the OH joined to this. It is, when pure, and at ordinary temperatures a crystalline solid, provided it is kept well corked. Water is very soluble in it, so that if it is left uncorked, an oily liquid consisting of a mixture of water and phenol is formed. It is soluble in water in varying proportions according to the temperature. At 20 degrees C. it dissolves in water to about the extent of six parts of phenol per hundred parts of water. It is colorless and is the lowest member of a series of homologues, a higher member of which is cresol; and there are yet considerably higher members that occur in the various coal-tar and wood-tar products. Blast furnace oil in particular has a considerable proportion of the higher homologues, and these are alone, or in conjunction with the balance of the blast furnace oil, particularly useful and effective flotation agents with certain ores.

By Mr. Williams:

Q. 83. You may name them, Professor, now.

A. I do not believe I can.

By Mr. Davis:

Q. 84. What is carbolic acid?

A. Carbolic acid is another name for phenol.

Q. 85. And it occurs in commerce in a crude form, as well as in the purified form?

A. Yes, in the crude form it is an element in many of the sheep dips and germicides, and various wood-preserving mixtures.

Q. 86. And if you take a freely-flowing ore pulp and add to it phenol, in the proportion of a fraction of 1 per cent on the ore, and put it in one of these agitation machines and agitate it, will it bring about a tendency for the metalliferous matter to rise to the surface of the pulp in the form of a froth or scum?

A. Yes.

Q. 87. And will the metalliferous particles be coated?

A. Yes.

Q. 88. And will the phenol be wholly in solution in the pulp?

A. Yes.

Q. 89. The next agents of the patent in suit are specifically—the next three are grouped together, benzoic, valerianic and lactic acid; what do you know about those things as flotation agents?

A. Benzoic acid is a substance that will give more or less satisfactory flotation, in so far as grade of recovered material and percentage of recovered material are concerned, with certain ores, provided that it is used in the requisite quantities. As I recollect, it is rather more than the usual small amounts that we are accustomed to, probably an uneconomical quantity. It is a crystalline solid, and is stated, at least in one of the books, to be soluble in the proportions of 0.34 parts per hundred parts of water at 25 degrees C.

By Mr. Williams:

Q. 90. What book is that?

A. At 25 degrees C. in Van Nostrand's Chemical Annual. It is a resin acid, and as such has of course been mentioned in certain of the patents that preceded the present one.

By Mr. Davis:

Q. 91. If you do not mind, Professor, we will put that off until after lunch, and we will take that up at the same time, in respect to where they have been mentioned.

A. All right.

Q. 92. Did you cover any of the acids besides lactic?

A. No, valerianic acid is one that I have talked about before, is one of the lower members of the fatty acid series and is soluble in water, completely soluble in water, when mixed therewith in small enough proportions. It is a colorless, oily liquid and one that it would probably be impossible to keep men in the mill with, if you attempted to use it in mill practice, because of the highly disagreeable odor. It is so disagreeable as to nauseate one. It will form a good mineral-bearing froth, representing a considerable recovery of mineral and a good grade of concentrate, when used in the proper proportions with acid with certain ores. Lactic acid is another organic acid that is soluble in water, and that will act as a good flotation agent when used with acid and with certain ores.

Q. 93. And if you add any one of these three agents to a freely-flowing pulp, in the proportion of a fraction of 1 per cent on the weight of the ore, and agitate in the agitation froth process, you will produce an agitation froth?

A. Yes.

Q. 94. Have any of these three agents, that is, benzoic, valerianic or lactic acids had any practical application in the industry of flotation?

A. Not to my knowledge.

Q. 95. The next agents mentioned are acetones and other ketones, such as camphor. What do you know about those things as flotation agents?

A. I have tried both acetone and camphor as flotation agents with acid in the agitation froth process, and have gotten with both, with certain ores, good recovery of mineral, in the form of a concentrate of good grade. A very considerable proportion, particularly of acetone, is necessary to use in water to get this effect, somewhere, as I recollect, between

twenty and forty pounds of the material per ton of ore, and at the price which you have to pay for acetone, that would not make very much of a flotation agent, but you can get the result with it if the question of cost is eliminated.

Q. 96. Does that cover the ketones, such as camphor?

A. I stated also that I have made flotation tests with camphor. Those are the only two ketones that I have worked with. The ketones are another of these organic groups that comprise a considerable number of substances having similar chemical compositions, but with more or less of some particular group of carbon and hydrogen, and these are the two that are specifically mentioned and are the only two that I have made actual flotation tests with.

Q. 97. Do you know of any practical application of acetones and ketones as flotation agents?

A. No, except as they may occur in certain of the oils and natural compounds that are used.

Q. 98. In referring to that portion of the specification which describes the introduction of the air, you pointed out that you thought the expression was capable of a broad meaning to include the various pulp body froth-flotation processes, or, on the other hand, of a meaning limited to the agitation-froth process. Now, will you look at the claim and note there the definition of the manner of introducing the air, in the words, "Agitating the mixture to form a froth," and say whether you think that expression also is ambiguous.

MR. GARRISON: Is that not a matter for the Court, as to whether the expression is ambiguous or not?

MR. DAVIS: I will change that, if you want me to. It has a double meaning.

THE COURT: It is the ambiguity that is in it—that it has a double meaning.

MR. DAVIS: Judge Garrison emphasizes on the word "ambiguous." I am conscious, of course, that this direct question—that is, the question in this form—which is very frequently put to the expert witnesses in patent cases, is very frequently objected to. The purpose of the expert is to make plain to the Court the meaning of the technical expressions in the patent.

MR. GARRISON: What technical expression is there? I understand every word of it.

MR. DAVIS: It is technical enough, if your Honor please, to have given rise to twelve years of litigation.

MR. GARRISON: No, it has not. If your Honor please, the counsel is testifying, not the witness. All the witness has to do is to say yes. Besides that he is asking a question of law, and it seems to me it is entirely a matter for the Court.

THE COURT: Use some other word.

Q. 99. What, in your opinion, is the significance of the words "agitating the mixture to form a froth" in Claims 1 and 2 of the patent in suit?

MR. GARRISON: We object to that, if your Honor please, in that form. I cannot see how he is entitled to obtain from this witness a legal construction of language that is utterly unambiguous.

THE COURT: It is not legal; it is scientific.

MR. GARRISON: The scientific meaning of these words cannot have any other meaning than their natural meaning.

THE COURT: I should perhaps have said "technical."

MR. GARRISON: There is nothing technical about those words.

THE COURT: I do not know whether there is or not. There may be.

MR. WILLIAMS: He tied them up to the claim, what meaning they have in the claim, that claim which particularly points out the invention.

THE COURT: He may ask him what technical significance, if any, the words have. They may have a technical meaning that I do not know of.

MR. GARRISON: I am satisfied with that.

Q. 100. What, in your opinion, is the technical significance of the words "agitating the mixture to form a froth," as contained in the patent.

MR. GARRISON: That assumes that they have a tech-

nical meaning. The witness should first be asked, I think, whether they have a technical meaning.

THE COURT: The witness understands that if there is no technical significance he, of course, will not give any. What is the technical significance; is there any technical significance and, if so, please state it.

THE WITNESS: It is my understanding that the words describe a particular one of the methods of obtaining a froth concentrate, one of the pulp-body methods of obtaining a pulp concentrate, namely the agitation froth method of doing so.

MR. GARRISON: That demonstrates the vice of that question. He does not state that is the technical significance in this profession or any other profession or of any art. Any witness may say in his understanding it meant another thing.

THE COURT: He says the words have the ordinary meaning, but your idea is that that is the particular process that they usually refer to?

THE WITNESS: The word "agitation" is a word that has a very broad meaning, and I think it is loosely used, and I think where you use the word "agitation" in connection with flotation, you must consider what the agitation is for. Now, in the agitation-froth method of bringing about froth flotation, agitation is for the purpose of causing the selective gas precipitation that will take the mineral away from the gangue. In order to do that, it has got to have a certain degree of intensity and duration. Anything less than that would not do it. It is quite a definite thing, and so when it says here "agitating the mixture to form a froth" it indicates to me the agitation method, because agitation was essential in the other pulp-body processes merely for the purpose of dispersing the oil, but if you can use some other method of dispersing the oil, it was possible to dispense with agitation. It played no part in it; but in the agitation-froth process the agitation was the absolute essential of the operation of the process.

THE COURT: So, in the art, you think that these words would have that scope?

THE WITNESS: I think that they would tie it right down to agitation of such intensity and duration as would bring about the essential gas precipitation, selective gas precipitation.

THE COURT: I think that is all right.

Q. 101. Professor Taggart, you have had a great deal of experience in mills and have met a great many mill men in your career in this flotation art, have you not?

A. Those are relative terms. I have met a lot.

Q. 102. Have you any doubt in your mind that if you said to one of the mill men that at such and such a mill the flotation is effected by the process in which the froth is formed by agitation—have you any doubt that he would understand that you meant this agitation-froth process?

MR. GARRISON: I object to the form of that question.

THE COURT: It is simply another way of putting to him the question as to what would be understood in the art by these people.

MR. GARRISON: It is a supposititious question about what one man, we do not know of, would understand by some words this gentleman might put to him.

THE COURT: I think it is answered in the previous question.

MR. DAVIS: I do not think the point was covered, if your Honor please.

THE COURT: There is no objection, in my point of view, in asking what was meant by these words in the art. I understood him to say that it was so understood in the art.

MR. DAVIS: He said "I understand it to mean." I want to bring out what other men would understand it to mean; that is, the understanding in the art.

THE COURT: I believe that the witness has already given that answer.

THE WITNESS: Yes.

MR. GARRISON: I object to that.

MR. DAVIS: Then, strike out the whole question.

If we may adjourn for lunch now, I may go back to this reference and not break the continuity.

THE COURT: How much longer do you expect to be with Professor Taggart?

MR. DAVIS: I expect to finish with him by this afternoon, I hope by three-thirty.

(Recess taken until 2 o'clock p. m.)

AFTER RECESS

By MR. DAVIS:

Q. 103. Have you prepared a table, showing the solubility graphically of some typical flotation agents, and can you let us have it and describe it?

A. I have. This chart which I shall label "Chart showing graphically the relative solubilities of certain flotation agents in water" is made up from numerical data, setting forth the solubilities of the agents as determined by agitation of them with water, in substantially the proportions that they are used in in the agitation-froth process, and for substantially the duration and with substantially the intensity of agitation that is there practiced.

By THE COURT:

Q. 104. How about temperature?

A. And at what we may call a normal temperature, that is about 20 degrees C. We attempted to keep them within a degree one side or the other of that, although we did not keep them exactly at 20, because it involved considerable experimental difficulty. It includes as the least soluble of the lot, kerosene, and the most soluble, phenol, substantially pure. The kerosene is soluble to an extent of less than half a per cent, when mixed with water in those proportions and under the conditions mentioned. The phenol was completely soluble. In the order of increasing solubility, the substances run kerosene, olive oil, fuel oil, linseed oil, crude oleic acid, crude coal tar, oleic acid of substantial purity, coal tar oil, crude carbolic

acid, coal tar (that is, another coal tar), coal tar oil (and that is another coal tar oil), blast furnace oil, eucalyptus oil, pine oil, the cottonseed oil-sulphuric acid mixture that is mentioned by Everson, oil of wintergreen, cresol, X-cake and phenol.

By Mr. Davis:

Q. 105. Will you describe the coloring of that chart?

Mr. Davis: I am sorry we have no duplicates of this chart, but we have only one. I offer in evidence the chart that the witness has produced, as Defendant's Exhibit No. 95.

Mr. Garrison: If your Honor please, so that there may be no confusion, we will have no objection to this paper that he is questioned about, but at the present time there is nothing on the face of it that indicates the proportions of the material and the proportions of the water with which it is mixed. I should object to that if it is not on the chart, and while Mr. Davis thinks it should go in evidence, I should be precluded from stating any objection if he does that first.

The Court: I suppose that is a graphic and convenient way of expressing his testimony.

Mr. Garrison: I have no objection if it appears he has something here.

The Court: If he can supplement that with the necessary figures, it will be all right.

Mr. Neary: He has already testified to the proportions.

Mr. Davis: I think it would be better to have it in evidence before he describes it.

Q. 106. Will you please describe this chart, defendant's exhibit, which will be marked Defendant's Exhibit 95, and tell what the figures and coloring on it indicate?

A. The distances toward the right of the rectangles colored red set opposite each of the named substances and measured from the common vertical line at the left-hand margin of the sheet, represent graphically and to the scale

that is marked along the bottom of the sheet, the percentage of the particular substance named that dissolves in water, when it is agitated with the water for a definite period of time, and when the proportion of the substance to water is one in four thousand, and when the temperature is in the neighborhood of 20 degrees C.

MR. GARRISON: You do not say whether the one to four thousand appears on that chart.

THE WITNESS: It does not appear, I am perfectly willing to make it appear.

MR. GARRISON: I am not criticising, but so that when we look at it hereafter we will understand it. Does the one to four thousand relate to the other substance?

THE COURT: His testimony supplements that.

By THE COURT:

Q. 107. The whole business is 100 per cent, and the other fractions are indicated graphically there?

A. Yes, sir.

MR. GARRISON: Professor, did you have the same amount of material and the same amount of water in all the other substances?

THE WITNESS: I stated that.

MR. GARRISON: State it again—one to four thousand?

THE WITNESS: One to four thousand.

Q. 108. What is that blue line?

A. The blue line represents the re-agent that is used by the defendant, namely, X-cake.

THE COURT: Just to emphasize that.

THE WITNESS: And it is merely to bring its position out that it is colored blue instead of red.

A comparison then of the lengths of these various rectangles will give an idea of their respective and comparative solubilities in water under the conditions mentioned.

Q. 108-a. And by measurement give the actual relation?

A. Yes sir, as closely as it is possible to read on this scale, which is within at least one-half of 1 per cent.

MR. DAVIS: I offer this in evidence.

(Received in evidence and marked "Defendant's Ex. No. 95—Taggart Chart of Solubilities.")

Q. 109. Now, returning to the specific flotation agents mentioned in the patent in suit, will you say whether or not they are properly described, in your opinion, as oils or oily substances?

A. No, they are not all.

Q. 110. Please say what ones are and what ones are not?

A. Amyl acetate is properly described as an oil or oily substance; likewise phenol and cresol, one of its homologues, and also the various higher tar phenols or tar acids that occur in certain of the coal-tar creosotes. Valerianic acid is also properly described as an oily substance.

THE COURT: All the others named are not, then?

THE WITNESS: The others are not, those that are specifically named.

Q. 111. Where, if at all, in the earlier patents and publications that you refer to, do you find any reference to the use of amyl acetate as a frothing agent beyond such reference as is made by the broad terms "oils and oily substances?"

A. I find no such reference.

Q. 112. Where, if at all, in the prior patents and publications do you find any specific reference to phenols and cresols as suitable for frothing agents?

A. Cresol is mentioned specifically in British Patent No. 17,109, United States Patent No. 777,274, Australian Patent No. 966, of 1904, United States Patent No. 788,247. Phenol is specifically mentioned in the same four patents.

Q. 113. Will you make a like reference to the prior patents and publications with respect to benzoic, valerianic and lactic acids?

A. Benzoic acid is not specifically mentioned, but is of course a resin acid, as was mentioned this morning. Valerianic acid likewise is not specifically mentioned, but is one of the broad class of fatty acids that was stated this morning. Lactic is not specifically mentioned.

Q. 114. How about acetones and other ketones, such as camphor?

A. Neither acetone nor other ketones are specifically mentioned.

Q. 115. What is fusel oil?

A. Fusel oil is a mixture of alcohols, amyl alcohol being the principal constituent.

Q. 116. Has fusel oil been specifically mentioned in these prior patents and publications?

A. Yes, fusel oil was specifically mentioned in the two Bessel patents, namely 42 of 1877 and 39,369 of 1887, issued by the German Empire.

Q. 117. Is fusel oil an organic amyl compound?

A. Yes. That answer would perhaps be more correct, Mr. Davis, if it was stated that fusel oil contains amyl alcohol, which is an organic amyl compound.

Q. 118. Will you refer to the British Patent No. 27,749 of 1913 for improvements relating to the concentration of ores to Henry Livingstone Sulman and Minerals Separation, Limited, and tell me what that patent discloses?

Mr. Williams: I object to the reference to this patent issued in 1913 as having any relevancy to the issues in controversy here, because it is so far subsequent to anything that is here under consideration. It is not even a patent issued to the plaintiff. It is a patent issued to Henry Livingstone Sulman and to Minerals Separation, Limited, of London. The plaintiff is Minerals Separation North American Corporation, and we are not responsible in any way for patents that were issued to Minerals Separation, Limited, of London, so that the document has no relevancy whatsoever that I can see. It is not prior art. It is not a statement on the part of the plaintiff. It in no way binds the plaintiff, and it certainly is not entitled to consideration as a scientific publication, if that is the theory upon which it is put forth. It is a patent.

The Court: What is your theory, Mr.Davis?

Mr. Davis: The patent is offered to prove or help

prove that these organic mineral compounds have all of them a soluble constitutent. The patent is granted for the use of the soluble constituent of oleic acid as a frothing agent, and it is evidence, in the first place, that oleic acid has a soluble constituent, and in the second place, that such soluble constituent is suitable for use as a flotation agent. I think the question is pertinent, quite aside from the question of whether or not it binds the plaintiff.

THE COURT: I did not suppose in the introduction of a patent it was proper to prove a fact that might be claimed in the patent to be a fact.

MR. DAVIS: Well, I take it that your Honor thinks that on that ground alone it is not admissible. That brings us to the other ground, which is that it is a patent issued to the plaintiff's predecessor in title—that is the plaintiff Minerals Separation North American Corporation's predecessor in title, and to a company which is in our contention a plaintiff here in court, because despite your Honor's ruling, we continue to think that the Minerals Separation, Limited, is in court, and I should like to have a further opportunity to argue that question at the proper time. It seems to us—well, to express our view briefly, it is this, that when this amended and supplemental bill was filed, it was both an amended bill and a supplemental bill. It contained an amendment to the pleadings in the respect that it struck out from them the charge that the first patent was infringed. It supplemented the pleadings, in that it alleged a different title. Now, under the rules those two things are entirely separate. As a supplemental bill, we were entitled to a trial on it, if we demanded it, I take it. The issue raised is a triable issue, and we might go to trial on that issue alone, and in that trial the Minerals Separation, Limited, would certainly be a party plaintiff.

THE COURT: Having already ruled on that, I think I will continue that attitude.

MR. DAVIS: That would exclude it?

THE COURT: Yes.

MR. DAVIS: Now, there is still a further ground on which we believe it is admissible, and that is that it is conduct of a predecessor in title to the plaintiff here, and this is a declaration against the title. Under that rule, it seems to me it is clearly admissible.

MR. GARRISON: Not a declaration against our present patent.

MR. DAVIS: Why not? It is a declaration very clearly against their title to the monopoly which they here assert.

MR. WILLIAMS: As a matter of fact, we have shown that in July of 1913 the whole beneficial interest of the patent in suit passed to this plaintiff. Here is a document in which even the filing of the provisional specification of the British patent is December 2nd, 1913, was subsequent to our acquirement of our exclusive beneficial interest in this subject, so it is an act wholly subsequent; even if it could be related in any other respect, it is out of the chain of dates.

THE COURT: I do not suppose this could be regarded as a declaration against title. You have not convinced me. I think I will exclude it.

MR. DAVIS: May I have it admitted under Rule 46, making the statement that I propose to prove by it that there was issued in England a patent to the persons that are named in the question, for the subject matter of using a soluble constitutent of oleic acid as a frothing agent. Now, I have in my mind an abandoned United States patent application——

MR. GARRISON: Have you departed from the other yet? I would prefer not to depart from the other.

THE COURT: That is in connection with it, I take it.

MR. GARRISON: I want to look at Rule 46 and see what he was asking for.

MR. DAVIS: I was finished with this. I simply wanted to make that declaration under Rule 46 to preserve my rights; and I may have an exception, of course?

THE COURT: Certainly.

MR. NEARY: I understand, under Rule 46, there is a permission by the Court to allow it to go in under Rule 46.

THE COURT: Let me see that, please.

(Handed to Court.)

MR. GARRISON: If your Honor please, I think we can obviate your having to consider this question. We are perfectly willing under Rule 46 to have this paper marked for identification, and then if the higher court should rule it out, they will have it before them, but we do not want it marked in evidence. That suits Mr. Davis, as I understand it.

MR. DAVIS: Yes, sir.

THE COURT: That gives you the benefit of whatever is done.

MR. GARRISON: Yes. Just have it marked any way they want for identification.

THE COURT: Yes.

MR. GARRISON: Are you going to have it marked for identification, Exhibit A for Identification?

MR. DAVIS: Mark it A for identification.

Marked "Defendant's Ex. A for Identification."

Q. 119. I direct your attention, Professor Taggart, to a certified copy of an abandoned patent application of Henry Livingstone Sulman, filed November 16, 1914, Serial No. 872,470 for "Improvement in concentration of ores," and assigned by mesne assignments to Minerals Separation North American Corporation. Will you please look that document over and tell me what is the subject matter therein disclosed?

MR. WILLIAMS: I object to any reference to this document, because it is a secret and private document, which is maintained within the secret archives of the Patent Office, an abandoned application for letters patent. We have permitted the defendant on our order to get a copy of it for the purpose of looking at it; but we reserved, of course, all rights of objection to any possible use of a document which is a secret document filed in the secret archives of the Patent Office, and some correspondence arising from it, and then abandoned by us——

MR. DAVIS: That is just what I want to show.

MR. WILLIAMS:—as pure, sheer nonsense.

THE COURT: What is your theory about that, Mr. Davis?

MR. DAVIS: The fact that I want to prove by this document is that the plaintiff company did file an application in the United States Patent Office and subsequently abandoned it, that application disclosing the use of a soluble constituent of oleic acid and other substances as a flotation agent.

MR. GARRISON: May I ask what is the question that you have asked this witness?

THE COURT: Yes.

MR. GARRISON: We can tell what it discloses as well as the witness. I think you had better offer the document and then we can make our objection thereto.

THE COURT: The question is as to the admission of the document and the admissibility of your questions concerning it.

MR. GARRISON: Yes.

THE COURT: I do not see how it is admissible.

MR. DAVIS: It seems to me it is an act binding on this plaintiff.

THE COURT: Not a public act, nothing for the information of the public by public declaration.

MR. DAVIS: I know, but does the publicity of the act add to or detract from the fact that they represented in the Patent Office that these soluble constituents of these oils did exist and were soluble-frothing agents?

MR. GARRISON: We withdrew that application.

THE COURT: They may have changed their minds. It simply shows a state of mind that at one time existed.

MR. DAVIS: That is precisely what they have done, if your Honor please, and what I am trying to show is just what they have done. I present it as evidence of an inconsistent position.

THE COURT: If they recanted I do not think you can

use it against them. I will exclude that and you may have an exception.

Mr. Davis: May I have it marked for identification in the same way under Rule 46?

The Court: Yes.

Marked "Defendant's Ex. B for Identification."

Q. 120. Mr. Taggart, will you please refer to the British Patent, Defendant's Exhibit No. 68, which is British Patent No. 26,852 of 1908, granted as a communication from Arthur Howard Higgins of Broken Hill, New South Wales, and state what is disclosed in that patent?

Mr. Davis: Would your Honor like to refer to that?

The Court: I have it right here. What is the number of your exhibit?

Mr. Davis: Defendant's Exhibit No. 68.

Mr. Williams: Of course he may explain what is disclosed. You do not want him to state what this thing states, but you want him to explain what it discloses?

Mr. Davis: Yes.

A. This patent describes a method for concentrating ores by froth-flotation in which a freely-flowing pulp is formed with water containing in solution certain specified substances. The mixture is agitated, thoroughly agitated, according to the specification, and a gas is "liberated in, generated in, or effectively introduced into" the mixture, as the result of which the metallic particles float as a froth or scum. It says, in connection with the phrase that a gas is "liberated in, generated in or effectively introduced into" the mixture, "The ore particles come in contact with the gas." And that then they float. As was stated this morning, with regard to the patent in suit, we have this rather puzzling description in the specification, that may refer either to all of the then-known pulp-body processes, or it may mean merely the agitation-froth process, and I think that the discussion of that particular phase that was given in connection with patent No. 962,678 this morning will apply also to this particular patent.

The substances that are to be used in the presence of

acid for flotation here are characterized in general as aromatic-hydroxy compounds, and several specific compounds are given. The aromatic-hydroxy compounds are a considerable number of substances that are grouped under this general classification, in the classification by chemists of the substances in organic chemistry, and they are characterized, in so far as the hydroxy compounds are concerned, by the presence in them of this OH radical or hydroxyl radical that I mentioned this morning.

By THE COURT:

Q. 121. Those are all inorganic substances mentioned, are they?

A. No, sir; these are all organic.

THE COURT: I thought he said all inorganic.

MR. GARRISON: He said "in organic chemistry."

Q. 122. I misunderstood him. And these are, in your opinion, all organic substances?

A. Yes, sir.

By MR. GARRISON:

Q. 123. Did you say it was known in inorganic chemistry or organic?

A. I said known in organic chemistry. The specific substances mentioned are phenol, cresol, salicylic acid or salicylates, hydroquinone, picric acid, pyrogallic acid, and they are all described as organic substances that enable metallic sulphide to float under the conditions of mechanical treatment that are specified otherwise.

By MR. DAVIS:

Q. 124. And they are said to be present there in solution?

A. They are said to be present in solution in acidified water.

Q. 125. Now, will you turn to the British Patent No. 28,173, of 1908, Defendant's Exhibit No. 70, and say what that discloses? The patent was granted to Henry Livingstone Sulman and Hugh Fitzalis Kirkpatrick-Picard and John Ballot.

THE COURT: What is the number of this one on your list of exhibits?

MR. DAVIS: No. 70.

A. This patent describes the process or processes of concentrating ores in which the metallic sulphide particles are separated from the gangue particles, by first making the usual freely-flowing pulp and adding to it the mixture, or adding the ore to a solution of a very small percentage of certain alcohols, such as amyl alcohol, the solution containing also a small percentage of a suitable acid, and the mixture is thoroughly agitated. The specification then states that "the ore particles are caused to come into contact with a gas, such as air, and the result is that the metallic sulphide particles float and can thereafter be separated by any well-known means," and then the specification goes on to describe two different methods of bringing about this particular result.

In one of them there is the regular agitation froth method that is described in United States Patent No. 962,678. The other one is a process involving perhaps some froth flotation, but apparently directed towards bringing about skin flotation also. That is most certainly skin flotation to which the apparatus is particularly directed, but with the possibility also that there may be some froth flotation following the agitation in this characteristic agitation vessel with the rotary stirrer. Various alcohols are specified, namely, methyl, ethyl, propyl, butyl and amyl, those being members of another one of these homologous series, and it is specified, of course, that these reagents when used shall be in solution in the acidified water.

MR. WILLIAMS: In regard to these two patents, there was no statement of the purpose for which they were introduced. The first specification that the witness read is dated June 28, 1909, which is even after the issuance of the patent in suit and long after the filing of it; and the second specification which the witness was reading from, is dated the same day; and these are not prior art at all, or prior patents. As a matter of fact they were not sealed until some time in January. They did not become patents until some time in May or June, 1910.

MR. DAVIS: If it will shorten matters, I think I will state that they are not introduced as prior publications or prior patents.

MR. WILLIAMS: I just wanted to have your Honor understand that, so as not to get a misconception.

MR. DAVIS: They are introduced on the defense that the invention was known individually to these men before they made the invention that they say is their joint invention. Higgins was one of the patentees and Sulman was another, and they had made application in Great Britain for these specific agents in solution, being specific instances of the very invention which they later claimed broadly in the patent in suit.

THE COURT: I presumed they were put in as illustrative of the prior knowledge of this art.

MR. WILLIAMS: Just to put the fact straight, the first of those applications was not made by Mr. Higgins, but was made by Minerals Separation, Limited, the applicants stating that the invention had been communicated to them by Mr. Arthur Howard Higgins, of Australia.

THE COURT: I think I am straightened out in my mind on that now.

MR. DAVIS: I should have perhaps directed your Honor's attention to that, but I assumed that the mention of the name carried the suggestion.

I will just direct your Honor's attention—I do not care to ask the witness anything further about it—to the fact that we have put in evidence United States Patent No. 955,012, which was issued on an application filed in this country by Sulman. We have put in a certified copy of the application. That certified copy shows that the application is based on the British invention, and our statute on the subject is that an application filed in this country, within twelve months after the filing of a corresponding application abroad shall have the same force and effect in this country as it would have had if filed here on the date the corresponding application was

filed abroad; so that the application in the United States, we say, has the same effect as though it were filed in the United States on December 24, 1908. The patent issued on it before the patent in suit, and under the authorities, which I will not burden your Honor with now, we contend that it is an anticipation; that it goes back to the filing date of the corresponding British patent.

MR. WILLIAMS: Did you plead that American patent in the way that you pleaded the others? It seems to me that you pleaded that as an anticipation, which, of course, it cannot possibly be.

MR. DAVIS: We pleaded it as an anticipation, and that is precisely what we say it is.

MR. WILLIAMS: It was filed in this country long after the application of the patent in suit.

MR. DAVIS: The rule of law is this, as I take it: in this circuit at least. It differs in the sixth circuit, and possibly in the seventh. At least in the second circuit the rule of law is this: that upon the mere presentation of the patent in suit with a certified copy of the file wrapper and contents, the patentee establishes his date of invention as of the filing of his application in the Patent Office.

The defendant comes forward with a patent which was issued before the patent in suit, but after the filing of the application for the patent in suit. Because of this first rule, that is too late. The rule in this circuit is that if he thereupon files a certified copy of the file wrapper and contents of the patent he is presenting as an anticipation something that carries the date back *prima facie* to the date of the filing of that application, so he has jumped back of his predecessor in this case. Now, actually the filing of the American application of Sulman here was too late for that, but the statute, as I say, is that the filing of the Sulman application here has the same effect as though it were filed on the date it was filed in England.

THE COURT: I understand your position.

Q. 126. Professor Taggart, does X-cake contain amyl acetate or other ester?

A. No.

Q. 127. Does it contain phenol or a homologue of phenol?

A. No.

Q. 128. Does it contain benzoic, valerianic or lactic acid?

A. No.

Q. 128-a. Does it contain acetone or other ketone such as camphor?

A. No.

Q. 129. You have observed in actual operation the process of Elmore, the vacuum process?

A. Yes.

Q. 130. And the agitation froth process of the Sulman, Picard and Ballot Patent No. 835,120?

A. Yes.

MR. GARRISON: You mean in the mill or experimental plants?

Q. 131. What do you mean?

A. In the mill.

Q. 132. Have you ever seen the Potter-Delprat process carried out?

A. Not in a mill.

Q. 133. Have you ever seen it in a laboratory, or how?

A. I have seen it in a laboratory many times.

Q. 134. In what size machine?

A. In a spitzkasten or pointed box about 18 inches deep and 8 to 9 inches on a side at the top.

Q. 135. And you have observed the froth in those three processes?

A. Yes.

Q. 136. Would you say that it was a fair comparison if I said that the Sulman-Picard frothing process and the Elmore Vacuum processes produce froths which are in no way less coherent than the froth of the Potter-Delprat process?

A. Yes.

Q. 137. Does the Elmore Vacuum process recover the slimes?

A. Yes.

Q. 138. And the froth-agitation process also recovers the slimes?

A. Yes.

Q. 139. In the agitation-froth process is the oil used for any purpose other than the adhesion of the bubbles to the mineral particles?

A. Yes.

Q. 140. What other purpose?

A. It is used to affect the surface tension of the water, and thus aid in the stabilization of the froth.

Q. 141. That is, it is used both as a froth-forming agent and as a selective agent, is that the idea?

A. It may well be stated that way, yes.

Q. 142. And it is not used at all for levitation?

A. Not at all.

Q. 143. Is that true also of the Elmore Vacuum process?

A. Yes.

Q. 144. Was it true of the Froment process?

A. Yes.

MR. WILLIAMS: Is the witness answering about things that he has seen?

MR. DAVIS: That is for cross-examination, Mr. Williams.

MR. WILLIAMS: I do not know whether this is intended to follow along the line you are asking him about. You asked him what he had seen in practice, and then you asked this question on the same line, and it may mislead to the belief that you are asking him whether what he is talking about now is something that was ever worked, and I think you should be definite and clear. I move to strike out the answer, your Honor, and move to have the question clearly stated.

THE COURT: It appeared to be admissible to me. If you want to clear it up, you can ask him on cross-examination as suggested.

Q. 145. I should like to have in the record, if you have it available, Professor Taggart, a diagram—a curve sheet—

which will give to the Court a picture of the results as they are plotted when you start out to find out how much oil you need in any particular operation. That is, I understand it is customary to plot the results and show a curve that indicates the amount of flotation as against the amount of oil used, other conditions remaining the same. Can you furnish me with such a curve sheet?

A. I cannot now. I could prepare such a curve sheet.

Q. 146. I have something here that is not precisely what I had in mind, but will answer the purpose. Within this treatise is a diagram, showing the effect of decreasing proportions of oil, according to its title. Will you please explain to the Court what that diagram shows?

A. This is a diagram that is intended to show the facts as between froth production and granule production, as in the Cattermole process when the amount of oil is varied, all other conditions remaining constant. It shows by the shaded areas—in the left hand shaded portion, it shows the respective weights of granules with respect to the total amount of in the froth, based on the total mineral in the ore, that is raised or recovered with that particular quantity of oil. Thus if we begin at the topmost horizontal line, namely, that labelled 6 per cent., it shows that a very considerable percentage, somewhere, I should read, in the neighborhood of 90 to 95 per cent. of the total mineral that was present in the feed, is recovered in the form of something granular, and a very small percentage, perhaps less than 1, is recovered in the form of froth.

By Mr. Williams:

Q. 148. It says isolated floating granules in the chart, does it not?

A. I accept the correction, that are floated in the form of granules. Those may be floating there because of a bubble that is attached to them, or they may be floating by skin flotation. They are utterly unimportant with respect to the recoveries that are made at that point. Now, if we come down mineral present, and in the right hand shaded portion, reading horizontally at any elevation, the proportion of mineral

to the line marked 3 per cent., say, there appears to be a slight decrease in the percentage of mineral that is sunk, a slight increase in the percentage of floating mineral, and that mineral is stated to be floating as flocks as distinguished from granules, and again, those particles may be floating by reason of attached air bubbles, or they may be floating by skin flotation. At one per cent. there begins a considerable decrease, according to this chart, in the amount of mineral that sinks, and it is marked at that zone "granulation becoming indistinct." That is, the granules are probably not well formed, but flocky, as it were, irregular, and rather difficult to separate; the percentage of mineral thus granulated is less, although not very greatly less, than it was with the larger amount of oil, and the amount of the material that is floating increases as the amount that is sunk lessens.

THE COURT: That is all very clear. I see down below there the reason for the decision by the Supreme Court.

By MR. DAVIS:

Q. 149. Professor Taggart, you said several times in your testimony, speaking about the mineral particles in pulps where the frothing agent was in solution, that the mineral particles were coated with the frothing agent. Will you please explain that physical phenomenon?

A. Whenever there is a solution of one substance in another, the distribution of material in that solution is not the same throughout, that is, it is different at the surfaces of the solution, which may be the upper or gas surfaces, or the contacts with the containing vessel, or the contacts with any solid substance submerged therein, or with any other liquid that is adjacent to the first liquid.

This particular phenomenon of concentration from solution at surfaces is the well-known phenomenon of adsorption. I know from experiment that it is impossible to produce an attachment of gas bubbles to clean mineral particles; that the surfaces of the mineral particles have got to be coated with some substance—and ordinarily it is some organic substance— and that it does not make the slightest bit of differ-

ence whether the coating is with some substance that may be mixed with the water in such proportions that it does not all dissolve, or whether it is with some substance which, when mixed with water, will all dissolve. In either case, there is this concentration of the substance on to the surface of the solid particles as the absolute pre-requisite to the precipitation of gas thereon. That is adsorption which is a universal phenomenon. With any solute not substantially in solution, there may be adsorption, but the amount of material that is adsorbed out of a given solution, differs with different kinds of material, and that is because the energies at the contacts between the liquid and the different kinds of solids are different. Measurements have been made of the amount of adsorption of various substances from solution, they may be liquid substances, or solid substances, or gaseous substances. I have measured the actual adsorption in the case of certain flotation agents, against certain particular gangue and sulphide particles, and proved to my own satisfaction that there was substantial differential adsorption as between the sulphides and the gangue materials of these particular flotation agents, and it is that that I refer to as coating.

Q. 150. Can you give us one or two illustrations of the dependence upon the effect of adsorption in the arts, outside of this flotation art?

A. One well known is the industry of dyeing silks and other dyeing processes, which are built up very largely on adsorption processes. The de-colorizing of oil is a function very largely of the adsorption on some finely divided solid of objectionable coloring substances in solution in the oil. The removal of fusel oil from whiskey is another one of the adsorption phenomena.

Mr. Davis: Now, if your Honor please, I have finished with the testimony of this witness in regard to this subject of agents. I have brought out these processes, because they come in naturally; and I will proceed now and will close as rapidly as I can, to the defense of non-infringement; that is, to the defense that their process is limited to the agitation-froth process, that particular

aspect of the defense of non-infringement; of course, a great deal has already been said to pave the way.

Q. 151. Professor Taggart, will you please compare the defendant's pneumatic process of flotation with those pulp-body processes which you have already described, including the agitation-froth process?

A. The defendant's process, as described in the stipulation that I heard discussed yesterday and have also read, consists in the formation of a freely-flowing pulp, and the mixing with that pulp of a flotation agent that is substantially all in solution; then running that into a rectangular box with an inclined porous bottom, and blowing air into the mixture through that porous bottom. As a result of that treatment, there forms on the surface of the pulp in the box a column of bubbles—froth, if you choose to call it, although at that point I do not think it is quite properly so characterized—a column of bubbles, and these bubbles build up as the cell is first being filled, until they reach the level of the sides of the box, and then they begin to overflow as finished concentrate.

If you examine that particular operation with a machine that has a glass side in it, the first thing that becomes strikingly apparent is that as the bubbles come out of the body of pulp they are the same color as the pulp. Now, if you have been looking at the agitation-froth process, or any of these other pulp-body processes in the same way, and watching the bubbles come out of the pulp, they are the color of the mineral particles, and it is immediately apparent to the eye that the work of concentration has been finished in the pulp with these processes. Here, however, there is no such completion apparent, and, as a matter of fact, the exact reverse of that is apparent, that the concentration has not even yet started as the bubbles emerge from the pulp. Then, as the bubbles rise in the bubble column, there will be apparent a blackening, usually, of the froth—because ordinarily sulphide minerals are dark in color, and worthless minerals are light—and this progressive darkening of the color of the froth indicates a progressive increase in concentration. In other words, the concentration is taking place in this column of bubbles resting

on the surface of the body of pulp. That particular visual observation may be beautifully affirmed numerically by sticking tubes in through the side of the machine and taking out at the different depths small amounts of the material that is present at those particular elevations and assaying them for the percentage of metal that they contain. If that is done, it will be found in the operation of the defendant's process—in other words, in the operation of the pneumatic process—that just what has been seen, or what has been apparent to the eye, is the fact, and that along that particular vertical plane or section of the machine that is being investigated the assay is precisely the same or substantially the same from the bottom of the pulp to the top of the pulp; that the first sample taken at the bottom of the bubble column shows a mineral content that is substantially the same as that of the pulp itself; and if it were not for the fact that there is a slight variation in level there, so that it is extremely difficult to get just an accurate sample, it would be precisely the same. Then the next sample above that shows more concentration. The next, more concentration, until finally we build up to the completed concentration of the cell at the top of the bubble column.

If the same kind of sampling is done in the spitzkasten of an agitation-froth machine, on the other hand, as before, the assay of the samples down in the spitzkasten are substantially the same throughout, because it does not make any difference there whether the particles are distributed as individual particles throughout the pulp, or whether they are collected together on a lot of little bubbles. If you take a cupful the distribution will be substantially the same in either case, so that you would not expect any difference in assay down there. The key assay is the one just above the pulp surface. Now, in the pneumatic process that key assay is substantially the same as the pulp. In the agitation-froth process, it is finished concentrate; the evidence of the eye as to that fact is absolutely confirmed by the chemical assay and the figures thereof. This substantial difference in the place of concentration is apparent.

There is also a substantial difference in the way in which the thing is done; because in the agitation-froth process, the gas precipitates on to the surface of the individual particles down in the pulp, and hangs on to them, brings them up to the surface, and there the particles and the bubbles collect as a rather peculiarly coherent froth or scum. In the pneumatic process, in the first place, there is no attachment of particles to the bubble in the pulp, because there is not present in the pulp the peculiar condition of super-saturation that is necessary to bring about that attachment; and when the particles get into the bubble column, they are not rigidly attached to the bubbles. They are falling back off of them at all times; there is a race, really, between the rate at which the sulphide particles are falling back and slipping off the bubbles, and the rate at which the bubbles are going up; and the cell, for proper operation, is so adjusted that the rate of rise of the bubbles is a little bit more rapid than the rate at which the sulphide particles fall back, and a little bit less rapid than the rate at which the gangue particles fall back, so that there is a differential falling back. The sulphide particles, you can see them—I confess that I do not know the full reason for it, but this you can see—the sulphide particles seem to hug the surfaces of the bubbles as they fall back, while the gangue particles fall right straight through. Therefore, each of the sulphide particles has a long fall, because it has to go around all the corners in falling down, and the gangue particle runs away from it, and thus there is a differential draining, with resulting concentration.

Q. 152. Did you make one of the party that went to Superior on this trip of inspection of the defendant's plant, in connection with this litigation?

A. Yes.

Q. 153. Of whom was that party made up?

A. Do you want the whole party?

Q. 154. Yes, if you have it here; both sides.

A. Messrs. Davis, Neary, Sage, Bacon, Yerxa, Taggart, Perkins, Thompson, Callow, Williams, Kenyon, Grosvenor, Chapman, Higgins, Wilkinson, Wilding, Trotter.

Q. 155. And did you during that inspection at the mill, at Superior, make such tests of the bubble column, as you have just described; and if so, will you please tell us exactly what you did, and whether the representatives of the other side took part, and what the results were?

A. I did make such a test. We placed in one of the pneumatic cells in the defendant's plant, at a point distant some 8 feet, I should say, from the feed end of the cell, a series of ⅛-inch pipes, projecting through the side of the cell, about 6 inches into the body of the pulp and the bubble column therein, at varying heights above the bottom, there being, as I recollect, eight pipes in this vertical row. We also inserted at the level of the lowest pipe in this series three more pipes, one about four feet from the feed end of the cell, one about 12, and one about 16 to 18 feet, so that we had then two sets of sample pipes into the side of this cell, one a set that would take samples in a vertical section and another that would take samples along the length of the cell. These pipes were plugged with corks until the beginning of the sampling operation. The other ends of the pipes in the vertical row were connected by rubber tubes with either pails or bottles, according to whether they projected into the pulp or into the froth; the reason for the distinction in the method of connection being that the froth will not flow out, of its own account, of the sample pipes. We had to stopper the bottles so that we could connect to the suction apparatus. The other sample pipes along the bottom of the cell were connected directly to the buckets. After arranging with the plaintiffs that they might have representatives with Mr. Yerxa and myself, who took the samples of the material coming out through the tubes, we started to sample by taking out the plugs from these various pipes and allowing the pulp to run out into the sample bottles and pails. At the same time representatives of both parties took samples of what we call heads, tails and concentrates, namely, the feed or heads to the cell, the worthless discharge or tails, and the overflow or concentrate. These samples were then, by representatives of the two parties working together, weighed wet and dried, and

then weighed, and split up each into four parts, of which the plaintiff took one part, one part was sent to the mill office for assay, one part was sent to me for assay, and one part was held for assay in case there was any dispute between us as to the correctness of the results obtained. I sent the samples that were received by me to Ledoux & Company, who are recognized assayers in New York City, for assay, and I have their results here, as also the results that were reported to me of the assays at the mill. The samples were numbered X-1 to X-14 in order, X-No. 1 being the sample at the bottom of the vertical row, X-No. 8 being the sample at the top of the vertical row, and the X-2, 3, 4, 5, 6, and 7, progressing in order upward between the first mentioned and the last. X-9 was a sample of the feed or heads of the cell. X-10 was the sample that was supposed to be taken at the bottom of the cell, near the head end. This one was about 4 feet from the feed end and the bubble column extended so far down at this shallow end of the cell that there was froth or bubble column down to this level, and we could not make it flow off, so that 10 is missing. X-11 is the sample along the bottom towards the tail end from the vertical row. X-12 is taken from the bottom near the tail end. X-13 is the tailing sample and X-14 the concentrate sample from the cell as a whole. Now, we will consider first those samples that were taken from the pulp body. The assays are in percentage of copper as reported by Ledoux:

0.97, No. 1; 1.01, No. 2; 1.00, No. 3; 1.03, No. 4; 1.02, No. 5. That is, the maximum variation between those samples is as between 1.03 and .97, no variation at all. The first sample that was taken in the bubble column was 1.27. There is a start of concentration. This was taken a little bit above the level of the pulp, because it is extremely difficult in one of these big operating cells to land right on the division line. The level is changing a little all the time, so that here where we are just a little above the pulp level, the first assay is 1.27. Concentration has started. The next is 3.13—it is going up gradually. The next is 5.68, still progressing. The final concentrate taken right off the top—because we could not get

a sampling pipe right up into the very top of that overflow, so that we have to use the final concentrate for that figure—is 16.83. We go up then right regularly and gradually through the bubble column with the concentration. The tailing of the cell, which was sampled some 16 feet further along in the flow of the pulp from the bottom of our vertical series here, was 0.43, showing that the pulp had not been completely impoverished, or at least as much impoverished as it was going to be, at the point that we sampled, and the feed sample of 2.96 compared with our 0.97 sample, shows that in that first seven or eight feet there had been an impoverishment of substantially 2 per cent. in the total mineral content in that distance.

The mill assays as reported to me were X-1, 1 per cent. They did not carry that up to quite so great an extent as Ledoux did. X-2,, 0.9 per cent.; X-3, 1.0 per cent.; X-4, .09 per cent.; X-5, 1.1 per cent.

Those were the pulp samples, and they ranged between 0.9 and 1.1, a little greater range, but substantial check, considering that it was much rougher assaying by the ordinary every-day methods at the mill, than Ledoux practices. Then their samples in the bubble column ran along 1.5, 3.3, 6.1, the same concentration indicated, and the final concentrate of 16.9. Sample X-11 assayed 0.7; sample X-12, 0.4, sample X-13, 0.5.

Mr. Williams: Of course we need not state the stipulation which we usually do, that the assays of an established assayer will be accepted in evidence without any further proof, subject to correction.

Mr. Davis: I call your Honor's attention to the fact that the witness spoke of the length of this cell, and it was much longer than the cell in use at the last part of the year 1919, which has been testified about. I did not know whether that might introduce confusion into your mind about it. These cells are 24 feet long.

Q. 156. During that inspection did the plaintiff's representatives make any attempt to measure the velocity of flow or the degree of agitation in the pulp body and in the froth of those cells?

A. Yes, apparently.

Q. 157. Did you observe those attempts?

A. I did.

Q. 158. Will you please describe what occurred?

A. The apparatus that they attempted to measure the velocities of the currents in the cell with was a very ingenious apparatus. It consisted of a bent arm, carrying at the bottom, mounted suitably, a little 4-bladed impeller that moved when you blew at it, for instance, or moved it backward and forward through water, very easily, so that it would record, therefore, any current that flowed through it. Then there was a little eccentric on the shaft of this impeller, connected with a little rod that worked backward and forward for each revolution in a little enclosed cylinder, and therein apparently made an electrical contact, so that at each revolution of this shaft the electrical contact was completed by means of the eccentric rod. Wires extended from this apparatus to a magnetic pencil, with suitable electrical apparatus intervening, so that at each revolution the magnetic pencil made a mark on a piece of paper. There was also arranged another magnetic pencil, connected with a pendulum which, by suitable electrical contact, recorded one-second intervals by marks on the piece of paper—on the other edge of the same ribbon of paper on which the first magnetic pencil recorded. You will see, therefore, that by moving that paper along you would get along one side a series of marks, representing seconds, and along the other side a series of marks, representing revolutions per second, and if you counted you would have, for those particular intervals, the revolution of this little impeller. The impeller was so arranged on the rod that was inserted into the pulp that it could, from above, be turned around a horizontal axis, so that it could be made to measure a current that was coming downward, or one that was coming horizontally, or one that was inclining upward, and then also by moving the rod itself on its own vertical axis, you could get currents that were moving along the length of the cell, or currents moving across the cell, or those that were moving diagonally. The operators had considerable difficulty with

the apparatus at first, in getting it to record, but finally got it so that to my observation, at least, it was recording properly. That is, they, for instance, swung the apparatus back and forward in the cell, and whenever they did that the instrument recorded, and as nearly as you can judge of course, swinging your hand thus, it was moving at the rate of 3 or 4 or 5 feet per second. We don't have to bother very much with the difference between 3 and 5 feet. It is somewhere in that general range. I observed this apparatus being swung back and forward in the cell, and that was about the rate at which it was moving, and on the assumption that that was the rate, apparently the little impeller made about one revolution for each foot per second velocity of the material that was flowing past it.

Whenever they held the measuring apparatus still in the cell, it would go quite irregularly. It might go along for two or three seconds at perhaps two or three revolutions per second, and then it would stop maybe for two or three seconds. There was no particular opportunity given, because the plaintiffs were not particularly satisfied with the results that the apparatus was indicating, for us to take actual measurements at a given place and pull the paper through properly and get the proper record, but I was observing the thing very closely, and I think it is a perfectly fair statement of my observation that in the neighborhood of three-quarters of a revolution per second to one revolution per second would measure the average maximum results that they got by exploring the cell. That, on the basis of the method of calibration that I have indicated, would mean that the apparatus was measuring the velocities in the cell—maximum average velocities—somewhere in the neighborhood of a foot or three-quarters of a foot or a foot and a half per second. I am confirmed in my belief that those are fairly the right figures, because investigations of my own have indicated that those are about the velocities of the pulp currents in the cell.

Q. 159. Have you made such sampling tests, as you describe in the answer before the last, on other cells than

those out at Superior, and particularly have you made them on cells such as shown on the drawing accompanying the stipulation as to defendant's process?

A. Yes.

Q. 160. I will not ask you to go into detail, but simply to state what results you got in those tests, whether they checked with the results you got at Superior?

A. Yes.

Q. 161. You heard Mr. Wilding describe the demonstration apparatus that has been set up at Boston?

A. Yes.

Q. 162. Do you recognize that as apparatus that you yourself have seen?

A. The description of it would fit, certainly, apparatus that I have seen.

Q. 163. It was brought out yesterday on cross-examination of Mr. Wilding that in the demonstration cell the dead space at the discharge end was considerably wider than the corresponding dead space in the actual mill cell; and that the demonstration cell was smaller than the mill cell, so that proportionately the dead space was very much larger, that is, in proportion to the total; do you recall that?

A. Yes.

Q. 164. In your opinion, would that have any effect on the currents in the cell?

A. Yes, that would make, in my opinion—it would make, to my knowledge—a considerable difference in the currents in the cell.

Q. 165. What is your knowledge about it, and how did you acquire it?

A. I have a cell myself, that is, one of these five-ton or one-foot Callow laboratory cells, that Mr. Wilding describes, and I have run it under a great many different conditions, and have found that the proportion that the dead space, so-called, namely, this space above the discharge outlet, bears to the total length of the cell, makes a marked difference in the movement of the material in the cell. If the machine is operated as received, a current more or less like that Mr.

Wilding describes will occur in the machine, that is, in so far as direction is concerned; and if a piece of board, for instance, is dropped down into the cell at the discharge end, so as to lessen more and more the proportion that the dead space bears to the total length of the cell, the general character of this movement of material in the body of pulp decreases; that is, the smaller the proportion of dead space to the total length, the less there is of this circulatory current, as it may be called.

Q. 166. Can you tell us briefly why that condition of a large dead space sets up a circulatory current?

A. It is purely a question of heavy un-aerated water that is over the dead space at the end where no air is going in, just pushing down under the aerated water and floating it. That, of course, starts a movement away from the tailing end or the discharge end up the bottom, and of course as water there sinks and pushes under the aerated water, the water on top of it toward the discharge end of the cell settles down to take its place, and then the water at the top, at the head end, flows down hill into the depression caused by the last-mentioned movement, and a circulatory current is started.

Q. 167. Does that circulatory current have any effect, one way or the other, on the operation of the cell?

A. If it is too violent, it hurts the operation, but otherwise it has no effect at all.

Q. 168. It appears from Mr. Wilding's testimony that the ore which they used in the demonstration went right into the flotation cell with its full content of copper. Does that correspond to what actually happens in the mill, and if not, what difference would it make?

A. It does not correspond to what happens in the mill, because there, as described in the stipulation, the mill heads, so-called, are first, after grinding, passed over gravity concentration machines, namely, Wilfley tables, and there substantially half of the mineral content is taken out, so that the ore as it passes to the cells in the mill is very much lower grade than this material that Mr. Wilding was treating. Several results of that would be—it would be a little more difficult

for Mr. Wilding to get quite such low tails as they got in the mill; it would be easier for him to get a better recovery than is got in the mill, and, because of the greater mineral content in the ore, there would probably be a difference in the consistency of the froth that overflowed from the cell. The stability of the froth is considerably affected by the amount of solid material in it, and the greater the amount of sulphide material in the ore, the more there would be in the froth.

Q. 169. The greater amount of mineral?

A. The greater amount of mineral.

MR. DAVIS: That is all.

MR. GARRISON: May we have until tomorrow morning to prepare our cross-examination?

THE COURT: Yes; if you will try to make up tomorrow for this half hour.

MR. GARRISON: Yes, we will.

THE COURT: We will suspend until tomorrow morning at ten o'clock.

(Whereupon an adjournment was taken until tomorrow, Thursday, June 28th, 1923, at ten o'clock. A. M.)

FOURTH DAY.

Bangor, Me., June 28th, 1923.

Trial resumed.

Met pursuant to adjournment.

Parties present as before.

ARTHUR FAY TAGGART resumes the stand.

DIRECT-EXAMINATION (Continued).

MR. DAVIS: If your Honor please, Professor Taggart has some samples of a number of organic mineral-frothing agents in bottles, and I should like to simply have them identified, so that your Honor can see them.

THE COURT: Yes, I would like to see them.

By Mr. Davis:

Q. 170. Professor Taggart, will you produce samples of a number of these mineral-frothing agents and identify them?

A. Would you care to have them set up?

The Court: No, I shall not look at them now, but Mr. Davis may want to have you say what they are.

Mr. Davis: Yes, that is what I should like to do.

Mr. Williams: You had better put a question, and get it on the record?

The Court: Yes.

Mr. Davis: There is a question on the record.

Q. 171. If you will go ahead, Professor, and take each one and identify it.

A. This that I hold in my hand is a sample of refined wood creosote mixed—50 cc. of refined wood creosote, mixed with 50 cc. (that is, cubic centimeters) of water. The wood creosote forms a layer of, as nearly as I can read, 50 cubic centimeters on top of the layer of 50 cubic centimeters of water.

The Court: Have that marked.

Mr. Davis: Have that marked as Defendant's Exhibit 96, the bottle labeled Refined Wood Creosote, P. T. & T. Co. No. 200.

(Received in evidence and marked "Defendant's Ex. No. 96. Refined Wood Creosote P. T. & T. Co. No. 200.")

The Witness: The next is a sample of cresol U. S. P., the letters referring to a certain fairly high standard of purity, mixed with 50 cc. of water, the cresol in this case being heavier than water, forming the bottom layer. In so far as it is possible to read, the mixture consists of 50 cc. of each of the substances.

Mr. Davis: Mark it Defendant's Exhibit 97, labeled Cresol U. S. P.

(Received in evidence and marked "Defendant's Ex. No. 97. Cresol U. S. P.")

The Witness: The next is a similiar mixture of

fusel oil with water, and so nearly as can be read, the volumes are 50 cc. each. The fusel oil, being lighter than water, is at the top.

MR. DAVIS: Mark it Exhibit 98, labeled Fusel Oil.

(Received in evidence and marked "Defendant's Ex. No. 98. Fusel Oil.")

THE WITNESS: The next is a similar mixture of steam distilled pine oil, an essential oil, with water, and so nearly as can be read the respective volumes are 50 cc. The pine oil is lighter than the water and forms the upper layer.

MR. DAVIS: Mark it Exhibit 99, labeled Steam Distilled Pine Oil No. 5, Miami.

(Received in evidence and marked "Defendant's Ex. No. 99. Steam Distilled Pine Oil, No. 5 Miami.")

THE WITNESS: The next is a mixture of phenol, marked C. P. (meaning chemically pure), with water. The mixture was made by first putting 50 cc. of water into the graduate, and then adding solid phenol until the hundred cc. mark was reached by the mixture. The mixture was then shaken, and as I at present hold it, there is at the bottom, up to about 43 cc. mark, a settled mass of solid phenol. Directly above that a clear layer, extending up to the 55 cc. mark, and consisting of liquid phenol, or phenol with some water dissolved in it, and above that is a layer of cloudy water, the cloudiness being due to small droplets of undissolved phenol dispersed through it, caused by the shaking to which the mixture was subjected, in an attempt to dissolve the solidified phenol.

MR. DAVIS: Mark it Exhibit 100, phenol c. p.

(Received in evidence and marked "Defendant's Ex. 100. Phenol C. P.")

THE WITNESS: The next is a mixture of kerosene and water, 50 cc. of each, the kerosene forming a colorless layer, as nearly as can be read, of a volume of 50 cc. above water.

MR. DAVIS: Exhibit 101, labeled kerosene.

(Received in evidence and marked "Defendant's Ex. No. 101. Kerosene.")

THE WITNESS: The next is a mixture of Stockholm tar and water, mixed in so far as it was possible to mix them, in the same proportions. The Stockholm tar has settled to the bottom. The upper surface is quite irregular and reads at somewhat less than 50 cc. I should average it about 48 cc. There is a small amount of Stockholm tar also floating on the surface of the mixture, in the form of a brown scum, principally at the edges of the vessel. The total volume of the mixture appears to be a couple of cubic centimeters more than a hundred. That is due, I think, to the inclusion of considerable air in the layer of tar, and also to the fact that the tar being quite stiff and viscous, is hard to measure with any greater degree of accuracy.

MR. DAVIS: Exhibit 102, Stockholm tar.

(Received in evidence and marked "Defendant's Ex. No. 102—Stockholm Tar.")

THE WITNESS: The next is a mixture of amyl acetate and water, made in the same way. The amyl acetate forms a layer substantially, as closely as can be read, of 50 cc. in volume above the water. The amyl acetate is slightly cloudy, due to the inclusion therein of small globules of water that were introduced by shaking, and the fact that there has not yet elapsed sufficient time for them all to settle out. I think they will settle out within a few hours.

MR. DAVIS: Exhibit 103, labeled amyl acetate.

(Received in evidence and marked "Defendant's Ex. No. 103—Amyl Acetate.")

A. (Continuing) The next is a sample of oleic acid and water similarly prepared, the oleic acid forming a layer of, as nearly as can be read, 50 cubic centimeters on top of the water.

MR. DAVIS: Exhibit No. 104., labeled "Oleic acid, U. S. P."

(Received in evidence and marked "Defendant's Exhibit No. 104.—Oleic Acid, U. S. P.")

A. (Continuing) The next is a mixture of coal-tar creosote and water, the creosote forming a dark layer on the bottom. This sample was prepared in the same way as the others. The volume of the creosote layer is, as nearly as can be read, 50 cubic centimeters, and that of the water the same.

Mr. Davis: Exhibit No. 105, labeled "Coal-tar Creosote, G. N. S. No. 22."

(Received in evidence and marked "Defendant's Exhibit No. 105.—Coal-tar Creosote, G. N. S. No. 22.")

A. (Continuing) The next is a mixture of blast furnace oil in water, similarly prepared, the blast furnace oil forming a layer of substantially 50 cubic centimeters on top of the water, there being also a few droplets of the blast furnace oil stuck to the sides of the container down in the water layer. This sample was made up, as were the rest, by first placing 50 cc. of water in the container and then pouring in the oil. The blast furnace oil is of nearly the same specific gravity as the water, and the droplets broke down through. There is not a sufficient buoyant force acting upon them to tear them loose from the side.

Mr. Davis: Exhibit No. 106, labeled "Blast Furnace Oil."

(Received in evidence and marked "Defendant's Exhibit No. 106, Blast Furnace Oil—Bernuth-Lembcke.")

A. (Continuing) The next is a mixture of coal-tar and water, prepared in the same way. The coal-tar forms a layer at the bottom, slightly less than 50 cc. in volume, as I read it. There is quite a lot of coal-tar stuck on to the side of the container in the water layer. The coal-tar is a very sticky and viscous liquid and ran down the side of the glass and adhered to it as it was being poured into the container, and the water has not been able to displace it.

Mr. Davis: Labeled "Coal-tar—Miami."

(Received in evidence and marked "Defendant's Exhibit No. 107.—Coal Tar—Miami.")

Mr. Davis: That is all.

CROSS-EXAMINATION

By MR. WILLIAMS:

XQ. 172. Professor Taggart, you were asked at the opening of your testimony to give a brief review of the art of concentration by flotation with flotation agents which have a "preferential affinity for metalliferous particles," and you stated that many processes have been "described and used" in ore dressing practice within the last fifty or sixty years; and then you gave a long list of patents and a few publications commencing with the Haynes British Patent No. 488 of 1860. Did you mean to say that all the things that you described had been practically and commercially used?

A. No; many of them had.

XQ. 173. Now, confining yourself to commercial and successful use, and of course, speaking not from your actual knowledge which could not go back that far, but from what you have studied in the literature of the published records of successful and commercial mining operations, will you tell me when first, according to this literature, successful and commercial operations were carried on with what you have described as "a pulp-body process of flotation-ore concentration?"

A. I should say that the Bessel process described in the second Bessel patent of 1886, was the first statement that I know of a profitable application of pulp-body concentration froth-flotation in the art. It is stated therein that by this particular improvement over the prior boiling patent, the entire process has now become lucrative or profitable.

XQ. 174. Well, that is in the second Bessel patent?

A. Yes.

XQ. 175. And as we have that in the agreed translation, as I read it, there is a reference to the first patent, the statement of the objection to it, and then this sentence: "Only by this improvement has the entire process now become profitable." You agree with that?

A. I think that is quite a fair statement.

XQ. 176. So that you take that to be an indication that the Bessel process of the first patent was unprofitable and that the Bessel process of the second patent was profitable?

A. I do. I should think the first patent would have been quite unprofitable, because it is a very expensive thing to heat a large mass of pulp up to boiling temperature and keep it there.

XQ. 177. As I read your testimony, you said that in that first process there was a gas produced. What was that gas?

A. It was partly air and partly water-vapor, steam.

XQ. 178. And water-vapor—or steam?

A. Yes. Not necessarily visible steam.

XQ. 179. Well, steam ordinarily is invisible, is it not?

A. Yes.

XQ. 180. And how much water-vapor or steam, and how much air?

A. I should suspect the air was somewhat over two per cent. of the volume of the liquid that was used. The balance would be water-vapor.

XQ. 181. And in the bubbles that would be formed in the mass would you have the air and the steam mixed?

A. As heating begins, as the process operates, if you begin with cold pulp and begin to heat up as in a batch operation, the early flotation is largely by air-bubbles and the later flotation by bubbles that are largely filled with water-vapor. There is a good froth formed throughout by using either gas.

XQ. 182. And in the boiling operation, steam is generated in the mass, and that forms the bubbles with very little air in it, and before the boiling operation, the bubbles that are formed are more largely air—I have put it the other way, but not with any wrong intention.

A. I should suspect that that represents the fact, yes.

XQ. 183. What is the next thing in literature that indicates to you the carrying on of a successful and commercial operation with one of these pulp-body ore-concentration processes?

A. The Potter-Delprat process comes next in application,

if my recollection of chronology is correct, and the Australian publications and various American publications of the mining industry that I have read indicate that that was applied to the production of large quantities of concentrates over a considerable stretch of time, particularly in the Broken Hill field in Australia.

XQ. 184. Well, that is one mine. The large operations were at one mine?

A. I do not recollect at present whether the records that I have seen are confined to one mine or not.

XQ. 185. But you do know that at the Broken Hill Proprietary, as widely published, it was used?

A. I am not sure that I have the names of the mines straight in my mind at all.

XQ. 186. What was the next successful and commercial process of ore-concentration of the pulp-body type, as you have termed it?

A. I think the Elmore Vacuum comes next, and as my recollection goes of the literature that was in competition with the Potter process in the Broken Hill field I think that it was also applied at some mines in Sweden; and I am not at all sure, but I seem to recollect also somewhere in Wales. I may be wrong on the latter, but speaking from general recollection and knowledge as to the latter.

XQ. 187. And as to the year—of course, I do not need to remind you that the publication that you have referred to was 1907?

A. 1907. Well, I cannot fix the dates of the various publications that I have read, Mr. Williams. The 1907 one, of course, I could.

XQ. 188. What does the literature show of the use of that Elmore Vacuum process today?

A. I know of no place that it is used to day.

XQ. 189. What does the literature show as to the next?

A. I should say the agitation-froth process was the next, or coincident with the Elmore, so far as any knowledge that I have as to the introduction is concerned.

XQ. 190. And I am not sure that you made it quite clear,

but what process did you refer to as the agitation-froth process?

A. That described in the United States Patent No. 835,120.

XQ. 191. You said something about the Elmore Vacuum process having been used in this country; did you?

A. No. I have seen the Elmore Vacuum apparatus working in this country, however. I had forgotten that.

XQ. 192. On a commercial and successful scale and with operations that were profitable?

A. Well, I could not answer as to profitable. It was not doing as good work as the pneumatic apparatus that was working parallel with it in the mill.

XQ. 193. Where was that?

A. At the mill of the Miami Copper Co., in Arizona.

XQ. 194. When was that, about?

A. I would say three or four years ago, as I recollect it now.

XQ. 195. How long was it operated there?

A. I could not answer that accurately. I saw it operating during a visit of a week or ten days, and it is my understanding that it had been operating before that time,—no, I saw it start, and it is my understanding that it operated for a considerable length of time after that.

XQ. 196. And it was carried on in Section 7 Test Plant, was it not, of the Miami mill?

A. I do not recollect the numbering of the sections. It was not in the main part of the mill.

XQ. 197. In what they call the Test Plant, was it not?

A. It was outside the end of the main building furthest from the office. I think that is the Section 7 Test Plant, but I do not recollect.

XQ. 198. Now, that was honestly just a test operation, was it not?

A. It was an operation to find out what the thing would do. There was no idea of installing it as a commercial operation until it was found out what it would do.

XQ. 199. And, as a matter of fact, it was not installed as a commercial operation?

A. It was not installed—it did not do as good work as the pneumatic cell did alongside of it, as the pneumatic cell was developed. I have felt for many years that, if the vacuum machine had had the time and money spent upon it that some of the present operating apparatus have had, it would be a serious competitor.

XQ. 200. I did not ask you that.

A. I am sorry if I exceeded the question.

XQ. 201. In this operation in the test plant of the Miami Copper Company of the Elmore Vacuum process, were the slimes rejected before the ore was put through the process?

A. No, the machine was tested on the regular run of mill pulp.

XQ. 202. So the slimes were mixed in with the coarse material. There was no separation of slimes, is that right?

A. None whatever.

XQ. 203. Now, you do not know that that was a successful and profitable commercial operation, do you?

A. Well, I thought that I stated that it was not doing such good work as the other.

XQ. 204. But I have asked the specific question, you do not know that that was a successful commercial operation?

A. No sir, I have not the dollars and cents on the operation.

XQ. 205. Was that the only time you saw the Elmore Vacuum process at work in the mill?

A. Yes.

XQ. 206. And just to get the proper perspective of that test operation at the Miami mill, that was carried on during the accounting proceeding then under way, was it not?

A. Yes.

XQ. 207. At the time when you and others were spending a good deal of time in my office every week in connection with the testimony in that suit, and in a little interregnum in that testimony?

A. It was not carried on at the time we were in the office.

XQ. 208. Of course that was physically impossible, but

it was during an interregnum in that proceeding that you went out and saw this test operation going on at the Miami mill, is that not right?

A. Yes.

XQ. 209. And that was one of many variations of operation that were tried in that mill during and preceding that accounting proceeding?

A. Yes.

XQ. 210. Now, the first patent that you took up was the Haynes British Patent No. 488 of 1860, and at the end of your description of that patent, you said:

> "Subsequently it was possible to separate the oily matter containing the sulphide material from the muddy water containing the gangue, by floating the material off."

What did you mean, what material did you float off?

A. The bulk of oily material containing the solid matter.

XQ. 211. What is your authority for that in the patent?

A. Have you got a copy of the patent? I haven't.

XQ. 212. Yes.

A. I think that the description beginning at page 4, line 29, describes it:

> "Whereupon the agitation being still kept up, the agent acts upon the metal, and gradually effects the separation of the metal from the earthy or non-metallic matters of the ore or matrix, or ore and matrix, the earthy matter sinking to the bottom of the water, and the metal being retained by the agent."

It seems to me that it is quite clear, knowing what we do of the properties of the products there used and the tendency for a mass of the light oil and solid to float in a pulp, that the statement is intended to mean to make the separation by flotation. The bituminous matter or oil and fatty matters are generally of less specific gravity than water.

XQ. 213. Do you remember the percentage that was present in that patent?

A. Yes; I think he says about 1 part of the agent to 5 to 9

parts of the sifted ore, and then he gives some other variables there. There are variations, but 5 to 9 parts covers.

XQ. 214. So you think those masses of oily mineral would float off?

A. I think without doubt, yes.

XQ. 215. And your authority in the patent is the statement that the gangue sinks?

A. Yes, as quoted.

XQ. 216. In regard to the patent to Carrie J. Everson, No. 348,157, of 1886, you described the first method of the two methods disclosed in that patent, making a material by treating cottonseed oil with sulphuric acid; and you say that that is put into water containing a small amount of acid. What is your authority in the Everson patent?

A. It did not seem to me that I said that, Mr. Williams.

XQ. 217. I heard you distinctly, and the stenographer so reported it.

A. I thought I said that after the making of the mixture of cottonseed oil and sulphuric acid that water was added thereto to make a substance of somewhat salve-like consistency, and subsequently that was mixed with the ore and then the mass put into acidified water. That is my recollection of what I said.

XQ. 218. That is what the stenographer says you said and what I remember that you said.

A. I have not read it.

XQ. 219. This mass "is then kneaded into the dry ore and then the mass of dry ore with this material distributed through it is put into water containing a small amount of acid and kneaded around therein." That is not true, is it?

A. Are we discussing what this mass means, or whether there was acid in the water that the mass was put into?

XQ. 220. Whether the statement that the record says you made, that this mass is put into water containing a small amount of acid, is a true description of what the patent discloses?

A. I notice in connection with this first method at page 2, line 39:

"The stirring or incorporation of the ore with the liquid should of course be thorough for the purpose of bringing the mineral into contact with the oil and acid as completely as possible, and after such incorporation the mass is then in condition for the washing out of the quartz by the action of water which will be applied to the mass in sufficient quantities for this purpose."

Now, as the admixture of oil and acid and ore is stirred into the water, the water is, of course, acidulated.

In the second method——

XQ. 221. I am only asking about the first.

A. I beg your pardon.

XQ. 222. And then if the water is acidulated it becomes so by reason of the sulphuric acid in the compound that is put into it with the ore; is that right?

A. Sulphuric acid that is free in the compound.

XQ. 223. And the water before the ore is put into it is not acidulated water, but just plain water, according to the patent?

A. Well, the water into which the mixture is put immediately becomes acid, so that the acidulation starts as soon as the mixture goes in, it is rather hard to draw a line. If you take a basin, of course, before you do anything to it, it has no acidity in it.

XQ. 224. So far as the basin is concerned, you start with plain water?

A. Plain water.

XQ. 225. And then you put the ore and oil and acid that have been mixed together in it, a pasty mass—you put that in?

A. Simultaneously.

XQ. 226. And then as she describes it, you work it with your fingers?

A. Yes.

XQ. 227. And that squeezes out the gangue, and then of course there is another suggestion, is not there, of doing it in a machine?

A. Yes, I believe there is.

XQ. 228. Now, you said something there about that oily mass being separated by floating it. I am talking about the Everson first method.

A. Yes.

XQ. 229. Do you stand for that as an accurate statement?

A. Oh, absolutely.

XQ. 230. Now, if you will look at the description, you will find the last three lines of the first column, on page 2:

"The concentrated mineral will accumulate in a pasty mass or lump or lumps and will contain the metallic portion of the ore,"——

and so forth.

A. That is a quite accurate description.

XQ. 231. Those lumps float, do they?

A. Yes.

XQ. 232. How much oil was in them?

A. It is rather difficult to say.

XQ. 233. About five per cent.?

A. I think it is.

XQ. 234. It was generally agreed in the former litigation?

A. There is quite a lot of air in those things.

XQ. 235. Do you squeeze it in with your hands?

A. Yes.

XQ. 236. Do you call the Everson a pulp-body process of froth-flotation ore-concentration?

A. No, sir.

XQ. 237. And you do not call the Haynes that either?

A. No, sir.

XQ. 238. Who first invented that term "pulp-body process"?

A. I think that I did.

XQ. 239. You referred to the Elmore United States Patent No. 676,679, issued June 18, 1901, but you did not at that point at least describe the process of that Elmore patent. Will you just briefly describe it?

A. I think it was quite accurately described in the specification as follows:

"I * * * mix the ore with water—as, for instance, by the wet crushing method in common use — using a sufficient quantity of water to make a freely-flowing mixture, the fineness of the ore depending upon the particular kind of ore treated. I then place the ore in water in a suitable vessel, add a quantity of the oil depending upon the particular kind of ore under treatment, and then agitate the mixture without breaking up the oil into small globules. The metallic particles will adhere to the oil and be buoyed up and floated by it while the other constituents of the ore will remain in the water. The water and attendent impurities are then drawn off, leaving the oil and metallic particles."

XQ. 240. That is the process in which the oil buoyed up and floated the metal, that mineral that had been entrapped, is it not?

A. Yes.

XQ. 241. I think in the art there is a generally accepted term describing that kind of process, is there not?

A. "Oil buoyancy" is the term that I think describes it.

XQ. 242. And then there is another term which is not so descriptive, "bulk oil," is that right?

A. That has been used.

XQ. 243. That process was very widely advertised and promoted, was it not?

A. That I cannot say.

XQ. 244. Has not your study of the literature made you aware of the fact that that was very widely advertised and spread all over the world and the knowledge of it?

A. There was a great deal said of it in the literature of the art, yes.

XQ. 245. Was it a commercially successful process so far as you know from your study of the literature?

A. Well, the only place that I know of its having been applied in mill operations—and what I say is from a study of the literature—is in Wales, I think it was. That is the only thing that I recollect at present. I have a sort of a vague recollection of its having been used at other places, but, of course, it could not compete in economy with present-day processes.

XQ. 246. It has disappeared quite completely, has it not?

A. It has disappeared most effectively, if you wish.

XQ. 247. Now you said in your evidence that Elmore Patent No. 703,905 was a patent dealing with the same type of process, and in view of the fact that this patent shows an oiled belt, greased belt, which picked up the mineral particles by the adhesion of the minerals for the oil or grease on the belt, what in general did you mean when you said that it was the same type of process?

A. That it utilized the preferential affinity of oily substances for metallic particles over gangue, for effecting the separation. I was not considering at that particular time the details of the method of making the mechanical separation after the selection had been made. I think it is quite accurate to describe this in so far as the mechanical feature is concerned as an oiled belt process.

XQ. 248. Well, it is also true, is it not, that it is a process in which the oil grips and takes hold of the mineral, and is the medium whereby the mineral is pulled out of the pulp?

A. Yes, it is held to whatever particular means is employed for getting it out.

XQ. 249. In describing in your testimony yesterday the process of flotation described in patent No. 835,120 of November 6, 1906, the patent that went to the Supreme Court of the United States twice—I say that for general identification—you used the expressions "beaters," "beater blades," "blades of the impeller." Now, what is your authority for that in patent No. 835,120? Have you got a copy of the patent?

A. Yes. Beginning at page 2, line 52, of the patent, is a description of the agitating vessel to be employed, and, referring to the drawing of that vessel, there is shown a vertical impeller, carrying near the bottom end, in the diagrammatic drawing, a section of a cone, in so far as the drawing is concerned, suspended in the air around the vertical spindle. Of course, it cannot be so suspended, and I know that it is attached to the spindle by rods or arms, and these rods or arms are the effective means of beating the air into solution

in the pulp and out of solution, as is necessary for the operation of the process.

XQ. 250. What does the revolving cone do in that apparatus?

A. Well, it purports to and does cause some guided flow of the pulp in the apparatus, but it has positively nothing to do with the concentrating operation that takes place. I have operated the thing in the position shown, and turned upside-down, and removed, but with the impeller arms left in, and absolutely the same result is got under the three different circumstances.

XQ. 251. What you call the impeller arms are the little spiders—the three-armed spider that supports the cone; is that right?

A. Yes.

XQ. 252. And they do all of that work of beating in that you have referred to as the principal feature of the process?

A. Yes, quite successfully.

XQ. 253. And for identification, what is the name in the art of that type of agitating vessel in which there is a rotating cone supported by a spider?

A. It is named Gabbett mixer.

XQ. 254. Named after the inventor Gabbett, is that right?

A. I presume so.

XQ. 255. I show you United States Patent No. 444,345, of January 6, 1891, to Edmund R. Gabbett. Do you recognize that as the patent for the Gabbett mixer?

A. Do you want me to read the patent or look at the illustration?

XQ. 256. I thought you were familiar with it, Professor?

A. I don't think I have ever read it.

XQ. 257. Well, just look at the illustration.

A. The illustration is similar to the apparatus illustrated in patent 835,120 for agitating the pulp, but the sides of the apparatus illustrated in the figure of this patent are

not so high in proportion to the width as they are in the apparatus illustrated in patent No. 835,120 and do not extend so far above the top of the cone.

XQ. 258. Then this patent shows internal ribs in the cone. Those are not present in the Gabbett apparatus as used in this art—that is right, is it not?

A. They are not present in the Gabbett apparatus I have used.

XQ. 259. And this has two spiders, and what you used has one spider; is that right?

A. No. The one that I used had two spiders, one at the top and one at the bottom.

By the Court:

XQ. 260. What is a spider, Professor?

A. It is a piece of metal that fits around the shaft and is fastened thereto, and has arms projecting from it out to this conical-shaped piece, and supports the conical-shaped piece at a distance from the shaft.

XQ. 261. What is the purpose of it?

A. It is to support the conical-shaped piece, so far as the apparatus is concerned; it is to beat in the air in the pulp in so far as it is—

XQ. 262. And the arms of the spider are the beaters?

A. Yes, sir; and their purpose is to beat the air into the pulp.

By Mr. Williams:

XQ. 263. And it is these spiders that compress the air in front of them and form a vacuum behind them and cause the action of the process, is that right?

A. Yes, quite accurately stated.

XQ. 264. And there is not anything in the patent about "beating in" or anything in the patent about the compression ahead of the spiders or the vacuum in rear of the spider arms?

A. I can answer you out of my head as to the latter part of the question. As to the "beating in" I will look it up if you wish.

THE COURT: Which patent are you referring to now?

MR. WILLIAMS: Patent No. 835,120.

A. I find no use of the words "beating in" or "beating air" in the patent; of course, the operation is implied throughout to anyone who understands the process.

XQ. 265. And then you said that you could answer as to the other part of my question, but you have not?

A. I thought I had. Let us find out the other part of the question now. (XQ. 264 repeated.) There is no description in the patent that sets forth the fact that there is compression of the pulp in front of the beater arms, the solution of the air thereby caused and the production of a vacuum behind the beater arms with consequent precipitation of the air on to the sulphide mineral particles.

XQ. 266. And there is no mention in the patent of beater arms, you said, I think?

A. I think I answered that.

XQ. 267. And there is no mention in the patent of the spider, no description of it?

A. No, "spider" is not mentioned.

XQ. 268. And it is not shown in the drawings?

A. No; in the drawing the cone is shown floating in air, so far as any support is concerned with respect to the spindle.

XQ. 269. The part of the patent, page 1, commencing line 89, following the description of putting the materials in and agitating them in the Gabbett reads "when agitation is stopped, a large proportion of the mineral present rises to the surface in the form of a froth or scum which has derived its power of flotation mainly from the inclusion of air bubbles introduced into the mass by the agitation." That is the description in the patent of the introduction of the air bubbles into the pulp, is it not?

A. Yes; that is correctly quoted and describes what happens in so far as drawing air into the pulp is concerned when a pulp is agitated by one of these rotary agitators. It has nothing to do with the way in which the attachment of the bubbles to the mineral particles is effected.

XQ. 270. But is there any other description in that patent either of the introduction of air or of the manner in which the air bubbles become attached to the mineral particles?

A. In answer to the first question, no. In answer to the second, there is no description anywhere in the patent, so far as I can see, as to how the bubbles become attached to the mineral particles.

XQ. 271. I read to you from your testimony yesterday, in answer to Q. 23, the end of the sentence: "I went ahead and checked out and actually measured the fact that there was a vacuum produced behind the propeller blade, and made the thing perfectly tight from the point of view of truth." Did you say "propeller" there or "impeller"?

A. I do not know which I said. "Impeller" is probably the proper word.

XQ. 272. How did you actually measure the vacuum produced behind the impeller blade?

A. I made an apparatus, one of these rotary stirring apparatus, with a hollow shaft and with one of the blades of the impeller hollowed out in such fashion that the hole connected on the inner end with the hole through the center of the shaft and at the outer end the hole emerged on the back of the blade near its outer tip. The upper end of the hollow shaft was connected by means of a stuffing box to a tube and from thence to a vacuum gauge. The impeller was then operated at different speeds and the vacuum behind the blade measured. The vacuum increased rather irregularly, that is, the vacuum started off very small until the speed got up, as I recollect it, between 300 and 400 revolutions per minute. Then there was a steep and substantially straight line increase in the vacuum up to the maximum that we were able to measure, which was about 12½ feet of water at somewhere in the neighborhood of 2000 revolutions per minute in this little three or four-inch impeller. At that point the device was beating air out of the water so fast that the air went into the hole back of the impeller blade and went right through and filled up the vacuum gauge, so it could not measure the vacuum beyond that point.

XQ. 273. What do you mean by a vacuum of 12½ feet of water?

A. The vacuum was as much below normal atmospheric pressure as is required to support a column of water 12½ feet high.

XQ. 274. Well, take the normal column of water at atmospheric pressure, how much is that roughly?

A. About 30 feet.

XQ. 275. Now, what would this column be reduced to with the condition that you have spoken of as a 12½-foot vacuum?

A. It is somewhere in the neighborhood of half a perfect vacuum. And of course the reason that I could not carry any further there was due to the defect of the apparatus. The vacuum is much greater in the actual big machines than I was able to measure.

XQ. 276. Was this with the Gabbett?

A. No, this was with an ordinary cross-arm straight-bladed impeller. I also made the same measurement with a forty-five degree impeller and got a slightly smaller vacuum for a given degree of revolution. What I mean is that with what I call the straight impeller with the blades up and down there is a greater vacuum pull than behind these inclined blades.

XQ. 277. The measurements you first gave were with a four-armed impeller with the vertical blades?

A. Vertical blades.

XQ. 278. Vertical blades.

A. Yes.

XQ. 279. Standing up vertically as they swing around?

A. Yes.

XQ. 280. And then you took some measurements with forty-five degree blades?

A. Yes.

XQ. 281. Which was the higher part as it went around? Was the inclination such that it tended to push the water up, or the inclination such that it tended to push the water down?

A. To push the water up.

XQ. 282. Did you take any measurements at 900 revolutions per minute?

A. Yes.

XQ. 283. What were those measurements?

A. Somewhere in the neighborhood of five or six feet is my recollection of the figures.

XQ. 284. And then at a thousand revolutions per minute?

A. A thousand would be a little less than a foot more. The curve was such that it went up somewhere in the neighborhood of two-thirds of a foot per hundred revolutions per minute.

XQ. 285. What was the diameter of the impeller?

A. Four inches, I think—no, three inches.

XQ. 286. And what was the width of the face of the vertical blades?

A. One-half or three-quarter inch.

XQ. 287. You do not know which?

A. I do not know which. It is a couple of years ago since I made that measurement, and the curve is quite fairly impressed on my memory, but the actual dimensions of the apparatus are not. I can get them for you if you like.

XQ. 288. Why, I think we would rather have your record than just your memory after two years.

A. The recollection as to the curve is substantially correct. That is, you can go ahead on that, if you wish. I can furnish it to you, I think, and the dimensions of the machine I think I can give to you this afternoon, because I have got an actual record of those here.

XQ. 289. And would that cover what you did with the 45-degree impeller, too?

A. The 45-degree does not, as I told you, go up so steeply.

XQ. 290. I mean, can you give me the particulars of that with the other?

A. Yes, sir.

XQ. 291. Well, if you can give them at a later time we won't take any time on it now.

A. No, I will have to get these for you at lunch time.

XQ. 292. Now, you said in your testimony yesterday that with the usual proportion of oleic acid for froth flotation you had made "actual quantitative determinations of the amount in which oleic acid is dissolved, and found that it was quite a sensible amount." What were those dimensions in figures?

A. Crude oleic acid 5.6 per cent,, and U. S. P. oleic, 8.02 per cent.—call it 8.0. I won't claim an accuracy up to around .02 for the method.

XQ. 293. Now, in the first place, how much oleic acid did you start with in proportion to water?

A. One part to 4000.

XQ. 294. Now, how did you determine that in the one case 5.6 per cent. of that oleic acid was dissolved and in the other case 8 per cent. of that oleic acid was dissolved?

A. You understand that those were two different samples and two different substances.

XQ. 295. Oh, yes, that is perfectly clear.

A. The same method of procedure was used in both cases.

XQ. 296. Just describe the procedure.

A. I took a jar that was square in cross-section, about 4 inches on an edge, and 12 or 14 inches deep, placed therein 1500 cubic centimeters of water and the proper amount of oleic acid to make the proportions 1 in 4000 (as I recollect the figures about .35 grams). This mixture was then agitated violently, as in the agitation froth process for 9 minutes by means of the ordinary square-bladed rotary stirrer, and then at the end of nine minutes there was added about 16 grams of finely ground infusorial earth, and the agitation was continued up to 10 minutes. It takes some time to get this earth in, so that probably the last of it was in only a few seconds before agitation was stopped. Then the mixture was poured onto a suction filter, and the first few cubic centimeters that came through (which are usually a little bit cloudy, showing there is still in the mixture some of the actually mechanically suspended oleic acid) were taken out and passed through

the filter again, and the mass was filtered to a clear mixture of oleic acid in solution in the water. The filtrate amounting to some 1500 cc., less what little bit is held back by the filter, is then divided, and a thousand cubic centimeters accurately measured are taken for the extraction therefrom of the oil dissolved in the water. To that solution was added about 250 grams of salt, in order to get a strong brine solution, and then four 100 cc. portions of ether were shaken up successively with the briny solution and separated therefrom. The ether was next evaporated in a small side-arm distilling flask and there was left as a residue at the bottom of this flask the oil that had been extracted from the water. In order to make sure that we were not weighing as oil more than was actually there, after the weighing we always test this residue for salt, and if there is any suggestion of salt in the residue, discard the test completely and repeat.

The oleic acid, therefore, that is in this side-arm distilling flask represents two-thirds of the total amount of oleic acid that was dissolved. The factor two-thirds enters from the fact that but 1000 cc. of solution was extracted, while we started with 1500 cc.; so that the weight of oil recovered multiplied by 1.5 and divided by the original weight of oil taken, gives the percentage of the oleic acid that passed into solution at that particular temperature, and under those particular conditions of agitation and proportion of oleic acid to water.

XQ. 297. And that operation was carried out at what temperature?

A. Ordinarily at 20 degrees within one or two degrees up or down.

XQ. 298. Normal temperature?

A. Yes. We did not work in a thermostat there.

By Mr. Garrison:

XQ. 299. Twenty degrees C.?

A. Twenty degrees C.

By Mr. Williams:

XQ. 300. And that is about 60 degrees F., is it not, or a little more?

A. I will agree with you on "about," somewhere.

XQ. 301. How did you identify this oily residue as oleic acid?

A. We made sure that it could not be anything but oleic acid, by running through a blank determination, in which the same operation precisely was carried forward, except that no substance was added to the water. We had also previously re-distilled the ether to be sure that there was no residue left from the ether itself. Then in case that in the blank operation there was any substance as residue, we deducted that from the amount of material recovered in the actual test before saying that the balance was oleic acid or any other oil that might be present.

XQ. 302. Of course, the blank operation was one in which you did not add oleic acid?

A. Yes. One in which we did not add oleic acid, but everything else was carried through in just precisely the same way, the agitation and the addition of the calcined earth, the filtration, the extraction with ether, and the subsequent collection and evaporation of the ether.

XQ. 303. Did that cause you to make any substractions?

A. Very small. The figure that we ordinarily got was, as I recollect it, about 0.006 grams. If it departed very far from that we threw out the infusorial earth and threw out the ether and used other substances until we got blanks that came to about that, because our experience in a great many of the solubility tests had shown us that we could get concordant results that agreed with published results and with experience, with that kind of materials.

XQ. 304. Now, how did you identify that residue as oleic acid?

A. Purely by elimination. There could not possibly be anything else there but that which had come out of the oil that was put in, and the oil that was put in was material that is bought under that name in the market. Of course, we assumed by elimination, that was oleic acid. There was no chemical test made for the actual determination of this material, because whether it is oleic acid, chemically pure or not, was not

of any particular importance in this particular connection. It was something that was soluble there and explained the flotation that we were getting with the different agents. We found always that when the solubilities ran down very low, we could not get any flotation.

XQ. 305. Can you give me the prior history of those two specimens of oleic acid?

A. Those particular two? Oleic acid, U. S. P., is material that was purchased from Eimer & Amend. I have bought, I do not know how many, one-pint bottles of it, but certainly a very large number, so I cannot identify it any closer than that. We analyzed many of them, and the figures run along from six to eight per cent. on all of them. The crude oleic acid is either —I can get it within three different substances—it either came from the Utah Copper Company, the Butte & Superior Mining Company, or, I think, it is Perry Brothers of Chicago. It is what is known as "red oil." We analyzed all three of them. I do not know which particular one this is; all ranged right around that same general position.

XQ. 306. That Perry Brothers' oleic acid was the first material used by the Butte & Superior in its flotation operations?

A. That I cannot say.

XQ. 307. You never saw the records of the company that showed that?

A. I may have seen the records that showed it; I do not remember.

XQ. 308. And it was one of these three you used, and you do not know which one?

A. I do not know which one, but I say we analyzed all three, and the figures were just about the same, so it does not make any difference at all which one you take.

XQ. 309. In these tests, could you see the undissolved portion of the oleic acid in the water after the agitation, the original agitation?

A. We could not in these particular tests, you see, because we had added infusorial earth during the last minute of the operation. If we had not added the infusorial earth, you

would have seen some amount of it surely; at least you would have seen the evidence of it in cloudiness of the water.

XQ. 310. How about the clarity of the material that you extracted? Was that interfered with by the infusorial earth?

A. No, not at all. The infusorial earth was used to clear it out. We filtered the mixtures.

XQ. 311. Did you look at that carefully?

A. Yes.

XQ. 312. Was that absolutely clear, and with no opalescence?

A. If they were examined just here, it would be clear. If you got into full sunlight, as was the case with quite a few of the others, there was the slightest suggestions of opalescence. It was apparently utterly impossible to filter out to perfectly clear mixture. You see, the material is undoubtedly dispersed there in all sizes from molecules and then aggregates of molecules as colloids, and then larger and larger groups, and, of course, the filter will take out at a certain dimension, so there were possibly some of the particles that were slightly larger than molecules that gave the opalescence. Of course, the opalescence is given by material that is in colloidal solution; and therefore that explains it.

XQ. 312. Did that liquid that you looked at, that had been separated, come up to the standard that you gave us yesterday?

A. What do you mean by that?

XQ. 313. You said, if it was perfectly clear and you could not see anything in it, then it was in solution?

A. Oh, yes, because if I were to take the thing right here and look at it, you would find it was perfectly clear. If you get it out there in the full sunlight and hold it against something dark, you would get a suggestion of opalescence.

XQ. 314. When you were talking about solubilities yesterday, you referred to Van Nostrand's Chemical Annual, Fourth Issue, 1918, for valerianic acid solubility. I think you

took the figure on line 25, page 374, did you not, and the solubility on the facing page 375?

A. Yes.

XQ. 315. Now, what is that little "n" alongside of "valeric acid"; what does that mean?

A. I suspect "normal."

XQ. 316. You are pretty sure that it means normal, are you not?

A. That is what I think, yes; that is what I accept that this means.

XQ. 317. The other book that you referred to yesterday was the Condensed Chemical Dictionary, of the Chemical Catalogue Company, Inc., First Edition, 1919; and this says "acid valeric, insoluble in water," that is what you refer to, is it not?

A. Yes, sir.

XQ. 318. If you just look at the other page, you will see under "acid valeric normal," "slightly soluble in water"; did you notice that?

A. No, I did not happen to notice that yesterday. I think I probably have noticed it before.

XQ. 319. That agrees with the table of solubilities, does it not?

A. Yes, fairly.

XQ. 320. And the substances that you picked out, instead of being acid valeric normal was acid valeric iso?

A. Yes.

XQ. 320-a. And that was a different substance?

A. Apparently.

XQ. 321. Then you made a mistake; I do not suppose you meant to, but you did make a mistake, did you not?

A. I would say that I did not make much of a mistake in what I was attempting to prove, and that is that the books were utterly unreliable on the subject of solubilities.

XQ. 322. So that the statement in the one book is consistent with the statement in the other book, when you take them as related to the same substance, is it not?

A. That is certainly true when you accept the "n" in this book for "normal," and I so accepted it.

XQ. 323. You produced a chart of solubilities yesterday. Who made the determinations of the solubilities that are shown in that chart?

A. My assistants, under my direction.

XQ. 324. Now, this chart, Defendant's Exhibit No. 95, shows a determination of the solubility of kerosene; as I read it, about one-half of one per cent. went into a solution of 1 to 4,000 parts of water?

A. Yes, that is what it reads on there without doubt, because I could not get it smaller. The figure for local kerosene was 0.012 per cent. Then there was another kerosene, rather more crude stuff, that has been used for flotation, that ran 0.4 per cent. That chart that you have is not to be read, I should say, within an accuracy of more than a half of a per cent.

XQ. 325. And in this determination of the solubility of these two kerosenes, you do not need to repeat, of course, but was the method followed substantially the same as you have described for oleic acid?

A. Just the same.

XQ. 326. And is that true as to all the materials that are shown in this chart?

A. Yes.

XQ. 327-8. And were there any chemical determinations of the residues made in these experiments?

A. To what do you refer as the residues, please?

XQ. 329. The residue is after you had performed all your separation and evaporated your ether and you got your little oily material; did you make chemical examinations of those residues to see what they were?

A. In no cases that I recollect.

XQ. 330. Now, taking the definition which you gave yesterday of a practical kind of solubility, not, for example, the solubility of glass, did you in the work that you did in making the investigations, the results of which are represented in this chart, determine in each case that the filtered liquid which

was separated was clear and free from opalescence in a bright, strong light?

A. Yes. Of course some of these things were made on days that were not sunny, and we did not hold up for sunlight.

XQ. 331. You used artificial light?

A. Yes, of course, that was merely the ordinary incandescent lamp, and all of them would show clear through that. You have got to get them in a pretty strong sunlight to discover any degree of opalescence at all.

XQ. 332. You were asked about various processes disclosed in the prior art yesterday, and testified about some observations of the processes, and particularly the Elmore Vacuum process. You have given us the only instance, have you not, in which you saw the Elmore Vacuum process at work in the mill?

A. What do you mean by "particularly the Elmore Vacuum process," Mr. Williams?

XQ. 333. You were asked about several at this place to which my question related?

A. What place was that?

MR. WILLIAMS: I withdraw the question.

XQ. 334. At page 330, Q. 137, you were asked: "Does the Elmore Vacuum process recover the slimes?" You answered: "Yes." Now, that knowledge which you there asserted of the fact that the Elmore process recovered the slimes, based upon actually seeing the process at work in the mills, was based upon what you said this morning, the operation in the Miami Copper Company mill; is that right; I am confining you now to knowledge of practical operations in a mill. Is there any other basis for it?

A. Why, yes, there are other bases for it. That is the only place that I saw the process in operation in the mill, but in this treatise there is a statement made——

XQ. 335. What treatise?

A. This treatise of Sulman and Picard.

XQ. 336. Well, we will leave that out.

A. You asked me for the other bases, I believe, for my statement.

XQ. 337. Actual knowledge?

A. If you are going to draw the line to what I have seen—in the mill, of course.

XQ. 338. That is all you ever saw of the Elmore Vacuum process at work in the mill?

A. I stated that a little while ago.

MR. WILLIAMS: I just wanted to make that perfectly clear.

XQ. 339. Now, you were asked as to whether the oil was used at all for levitation in the Elmore Vacuum process, and you affirmed the statement that it was not; and then you were asked: "Was it true of the Froment process?" That is, that the oil was not used at all for levitation, and you said: "Yes." Now, have you ever seen in a mill anywhere the practical operation of the Froment process?

A. I have never seen it in practical operation in the mill. I have been very much surprised that it did not develop into practical mill operation, because it does such remarkably good work in the light of what the state of the art was at that time.

THE COURT: He only asked you whether you have seen it.

THE WITNESS: I beg your pardon.

MR. WILLIAMS: I did not want to stop you, Professor.

XQ. 340. Now, you testified of inspection of the defendant's mill at Superior, Arizona, attended by representatives of the plaintiff and the defendant. When did that occur?

A. Somewhere early in May of this year, was it not? Do you want the exact date? May 2d and 3d.

XQ. 341. Yes, May 2d and 3d of this year. On what date was it that you took those specimens that you have described from the defendant's pneumatic cell?

A. May 2d.

XQ. 342. What were the dimensions of that pneumatic cell from which you took these measurements—these samples which you used as a basis of your figures?

A. Roughly 3 by 24 feet, as I recollect.

XQ. 343. And how deep?

A. I think about 14 inches at the head end and in the neighborhood of 18 inches at the discharge end.

XQ. 344. How was the ore fed into the cell at the head end?

A. Through a pipe that terminated a couple of inches above the bottom of the cell, and the pulp, therefore, entered very close to the bottom of the cell.

XQ. 345. And this was a vertical pipe, substantially?

A. Well, at the point that it discharged it was vertical. It turned from horizontal right at the back of the cell, so that there was about a 6 or 8-inch vertical extension downward from the turn.

XQ. 346. About how much material was rushing into the cell through this pipe?

A. What do you mean by rushing?

XQ. 347. Flowing then.

By the Court:

XQ. 348. How large was the pipe?

A. The pipe was, I think, 6 inches as I recollect it.

XQ. 349. In diameter?

A. Yes, it was not flowing full, and I do not recollect exactly—I think about a hundred tons of solids per 24 hours, if my recollection is correct. It may have been somewhat more.

By Mr. Williams:

XQ. 350. About 500 tons of water?

A. Between 400 and 500. They say nearer to 500.

XQ. 351. How was the X-cake solution introduced into the cell?

A. It was introduced through a small pipe that entered the mass of material in the cell near the feed end.

XQ. 352. Right alongside of the pulp feeding pipe, was it not?

A. Well, in that immediate vicinity. I don't believe that I saw their relative positions down in the cell. I don't believe that I noticed them.

XQ. 353. What was the depth of froth? Will you take

the word froth? What was the depth of froth in those cells?

A. If you include also bubble column.

XQ. 354. I will let you include it, but I won't.

A. All right, sir. The depth of bubbles was at the time that test was taken I think somewhere in the neighborhood of ten or twelve inches, it may have been more right at the —certainly acted as though there were more right at my No. 10 sampling pipe, or my first sampling pipe along the bottom.

XQ. 355. And then there was one place where you could not get a specimen of pulp?

A. That is the point I refer to. Right there at that pipe I think there was undoubtedly a solid column of bubbles from the blanket up. Certainly the evidence was all to that end, because I rammed a wire through that pipe myself several times, and know that it was clear through, so that the only thing that prevented material from coming out was the fact that there was froth right down to the level of that pipe at that point.

XQ. 356. And the froth will not flow in a small pipe, will it?

A. Not of its own volition; no.

XQ. 357. It is a very viscous mass of material, is it not?

A. It is viscous, and there is not much weight to it to cause it to flow.

XQ. 358. Why is it that you mentioned the fact that this surface between the froth and the pulp is changing all the time?

A. Because that is the fact.

XQ. 359. Kind of a wave action, is it?

A. I don't think you would call it a wave action; no. At one period it may be at one height, and half an hour later a half an inch above that, and another half hour a height of an inch below, more or less, according to the way the cell is being operated. The particular importance of my statement there was that these pipes are more or less fixed things after they are placed, and while we attempt to get one of them in at the pulp level, and may get it there for the day on which

the thing is put in or what it was the day before, it is just as likely to be running an inch below the next day, and an inch above the next day.

XQ. 360. Then I perhaps misunderstood you. During the time when you were drawing these specimens was there any change taking place so as to vary that factor?

A. I could not see it, Mr. Williams, and I could not distinguish closely enough with my hand to say so. I had my hand in there, because one or two of the pipes that we had connected onto the suction, with the expectation that they were going to be in the bubble column, proved to be in pulp, or just at the pulp-bubble column line, and if we had allowed them to run under the influence of suction they would have filled up the bottles much more rapidly than the other bottles filled, and consequently could not have been sampled throughout the period of the test. So those two I put my fingers over the inner end of, and then opened them, first one and then the other, as evenly as I could possibly do it, and for short intervals running throughout the test, so that the samples as taken from those two pipes were entirely comparable in percentage of material with those taken from the rest, but were not of course comparable in total elapsed time required to take the samples. That is, they were not flowing all the time. They were flowing for ten minutes, we will say altogether, but for perhaps half of that time I had the pipe shut off at short intervals, so that there was no flow coming at those times.

XQ. 361. You put your finger against the end of the pipe and stopped the flow?

A. Yes.

XQ. 362. Now, have you got those determinations that you produced yesterday?

A. Yes, I hand you the sheet I read from. The typewritten part of that sheet and the printed part is Ledoux's report to me of the assays that he made. The figures thereon in pencil are my own figures, representing the assays at Magma as reported to me, and set against the respective corresponding figures of Ledoux.

XQ. 363. I notice that the list does not include sample X-10.

A. That is quite correct. That is the sample that I mentioned yesterday as having failed to run, because of the fact that the bubble column probably extended to the bottom of the cell at that particular place. The sample tags were all made up before the test, and we just omitted that particular number.

XQ. 364. As I remember it, you did not read out yesterday the figures for the sample X-9. What was that a sample of?

A. X-9 represents the feed sample.

XQ. 365. And what are the figures?

A. 2.96 per cent. by Ledoux, 3.0 per cent. by Magma.

XQ. 366. Just exactly what is the feed sample?

A. A sample of the material that enters the cell.

XQ. 367. So that the material that entered that cell was about 3 per cent. copper. Is that right?

A. Yes.

XQ. 368. I am not quite sure that you particularly gave us the height in the cell of those pipes that were arranged in the vertical column.

A. I did not. Mr. Perkins and somebody of your representatives together measured, and I believe it was the understanding that they would agree upon the measurements of those pipes, and I think that I can get them. I perhaps can get them from Mr. Perkins if you would like. I haven't got them.

XQ. 369. You haven't yourself that information?

A. No, I did not measure them myself, and have not seen those other figures. I saw of course that they were in their proper positions in the cell, but what those precise positions were I did not measure.

Mr. Williams: Mr. Davis, we will have a complete representation, will we not, of that cell and of those pipes in it; you will supply that?

Mr. Davis: Why, I had not intended to, but if you will tell me what you want I will try to get it.

MR. WILLIAMS: I want a drawing of the cell, and I want a sketch of the cell, showing the location of these pipes.

MR. DAVIS: Well, your representatives were there and took all the measurements; why don't you have them make one?

MR. WILLIAMS: We cannot make a drawing of your cell. Have you not the blue print of your cell?

MR. DAVIS: We have not, Mr. Williams. If you had told me in New York I could have gotten one from Magma, but we have not any here.

MR. WILLIAMS: It is just a matter of getting the shop blue print, is it not, of the cells?

MR. DAVIS: Yes, but it is a matter of getting it from Superior, Arizona.

MR. WILLIAMS: Will you do that and we will put it in evidence after the trial, if you cannot get it during the trial?

MR. DAVIS: I will, certainly.

XQ. 370. Professor, you testified as a witness in the case of Minerals Separation, Limited, and others, versus Butte & Superior Mining Company, at Butte, Montana, in 1917, did you not?

A. Yes.

XQ. 371. I will read the questions and answers from the Supreme Court record. At page 1742.

"XQ. 126. Did you write or participate in the writing of an article which appeared in Metallurgical & Chemical Engineering, Volume 15, November 1, 1916?

A. I cannot remember the particular date of its appearance. I think I can identify the article.

XQ. 127. I show it to you.

A. Yes."

Did you so testify?

A. I think I probably did. I am assuming that you are reading correctly, and that sounds familiar.

MR. DAVIS: Have you got another copy of the record?

By Mr. Davis:

XQ. 372. You wrote the article, did not you, Professor, that is referred to there?

A. I wrote the article, yes.

By Mr. Williams:

XQ. 372-a. And you so testified—I will let you have a copy of the Supreme Court record, so that you may follow my reading and save time. That was on page 1742, XQ. 126-127.

A. Yes.

XQ. 373. And is that a photostat of the article in question (handing paper)?

A. Yes, I suppose it is, Mr. Williams. I never saw this Metallurgical & Chemical Engineering thing.

XQ. 374. What I now have is the paper as prepared for reading, is it?

A. That I recognize as a paper, a reprint of the article published by the American Institute of Mining Engineers.

XQ. 375. And you and Professor Frederick E. Beach, both of Yale Sheffield School, were writers of the article; is that correct?

A. Yes.

XQ. 376. In testifying in the Butte & Superior case, did you testify as follows, page 1744:

"XQ. 134. In testifying in regard to what you have called the agitation-froth process, you have confined your description to the agitation in one vessel and separation of the froth in another, as I understand it, is that right?

A. Yes.

"XQ. 135. You are aware, are you not, that the process is carried out with an agitator at the bottom of one vessel, air flowed in at the bottom of that vessel and the froth taken off at the top of the same vessel; that is known as sub-aeration; are you aware of that?

A. Yes, I have heard of it.

"XQ. 136. And then there is another variety, is there not, wherein there is no agitator in this vessel, but the air is broken up by flowing in underneath, through a porous medium and flows up and the froth is taken off at the top?

A. Yes.

"XQ. 137. And referring to that, did you in this article state as follows: 'The principles involved in this method are the same as explained in the agitation-froth process. The only difference is in the method of introducing air. The result of this difference is that the bubbles in the pulp are much larger than in the agitation-froth method. They arrive at the surface less heavily loaded in proportion to their weight. The bubble films are therefore less viscous and the froth less persistent'?

"A. Yes, sir."

Did you so testify?

A. I did.

XQ. 377. Did the article prepared by you and Professor Beach, and published at the time spoken of, contain the following: (under the heading "Pneumatic Froth Process"):

"Sulphide and gangue minerals mixed with water and oil, with or without acid, are run into a tank with a porous bottom through which air is forced. The air bubbles rise to the surface with a coating of solid particles, preponderantly sulphide, while the gangue particles sink.

"The principles involved in this method——"

That is just a repetition of that which I have read to you before. Did this paper contain that statement?

A. The paper contains that statement.

XQ. 378. On the last page of the paper, I read:

"But the agitation of the pulp in the mechanical and pneumatic-froth processes and the generation of carbon dioxide gas on carbonate particles in intimate contact with sulphides in the acid-froth process, are sufficient, in their——"

And that means the authors does it not?

A. Let me see. (Handed to witness.)

Yes.

XQ. 379. —"opinion, to bring every sulphide particle into contact with a bubble film. Once in contact, the preferential adhesion of the contaminated layer to a sulphide surface in the presence of water is sufficient to

account for the persistent attachment of the sulphides to the bubble films, while on the other hand the replacement of gas or oil by water on the surface of gangue particles explains the wetting and continued immersion of the latter."

That is a correct reading of what is in that article, is it not?

A. That is a correct reading.

XQ. 380. In that quotation you speak of the "acid froth process"; what process was that?

A. Let me see it, please. (Handed to witness.) Where was that, Mr. Williams? (Indicated.) Now, let me have the question, please. (XQ. 380 repeated as recorded.) The Potter-Delprat.

MR. WILLIAMS: I will just have the paper marked for identification. It was marked in the Butte and Superior suit.

(Marked "Plaintiff's Exhibit A for Identification.")

XQ. 381. In regard to the introduction of what you have called pulp-body processes of froth-flotation ore-concentration, can you from your knowledge of literature tell me what was the first introduction of any process of that kind into use in this country in a mill in commercial operations?

A. No, I cannot, Mr. Williams.

XQ. 382. You do not know that the Butte & Superior Hyde operation, which was testified about in the litigation in which you testified, was the first use in this country of a pulp-body flotation process?

A. No, I do not know that.

XQ. 383. Do you know of any earlier one?

A. No, I do not know of any earlier one.

XQ. 384. Do you know of any use of Potter-Delprat process at a mine as a commercial and successful operation in this country?

A. No.

XQ. 385. If I have understood your testimony correctly, you distinguish between a pulp-body process, which you contend is old and is the kind of process disclosed in the patent in

suit, and the bubble-column process, which you contend is the operation of the defendant; that is right, is it not?

A. Yes.

XQ. 386. And that you contend is the essential difference between the process disclosed in the patent in suit and the defendant's process, is that right?

A. What? You say, "That you contend"; what do you mean by that?

XQ. 387. One is a pulp-body concentration process, and the other is a bubble-column process.

A. I say that is an essential difference, certainly.

THE COURT: You say "an"; he said "the."

XQ. 388. An essential and important difference, that is as far as you will go?

A. Why, that is certainly an essential and important difference. However, the operation that is described—there is an operation described in the second patent in suit in which a soluble agent is used. A soluble agent is also used in the defendant's mill, so that in so far as that particular feature is concerned, there is a parallelism between that which is described in the patent in suit and that described in the defendant's mill. Of course, the use of soluble agents was also old.

XQ. 389. That is not in answer to the question.

THE COURT: You said, the second patent in suit.

THE WITNESS: I thought I said the patent in suit, sir. I meant the same thing, because the second patent in the older litigation was the patent here.

THE COURT: This is the second patent in the former suit?

THE WITNESS: Yes, sir.

XQ. 390. I will put this to you over again: The essential difference—and note, that I use the definite article "the"—is it the essential difference between the process disclosed in the patent in suit and the process used by the defendant, that the one is a pulp-body concentration process and the other is a bubble-column concentration process?

A. No, it is not the only essential difference, certainly.

XQ. 391. What are the other essential differences between the two processes?

A. Another is that the reagent that is used by the defendant for floating is something that is not pointed out, as far as I can see, in the patent in suit, as anything that it discloses to the art that is new.

XQ. 392. Anything else that you deem essential?

A. Yes, there is another. The pulp at the defendant's plant is alkaline, and as I read the directions to the mill man, to carry out the operation in this patent in suit, the pulp is supposed to be acid.

XQ. 393. Any other essential difference?

A. Well, I do not know whether it is really an essential difference or not. This patent in suit says that the frothing agent is in solution, and implies that it is not on the mineral particles, and if that is accepted as a correct explanation of the statement of what that patent means to describe, then the operation described in the patent is also different from the operation that takes place in the defendant's plant.

XQ. 394. But if the operation described in the process in suit takes place as you believe it takes place, then that is not any difference at all, is that right?

A. That what isn't any difference?

XQ. 395. What you have just specified, that in one case the frothing agent stays in solution, and in the other case the frothing agent is deposited, I think you said, on the mineral.

A. I say that in the process as carried out in the defendant's plant, the frothing agent is on the mineral. Now if the process that is described in the patent in suit excludes that from the operation, then the processes are essentially different.

XQ. 396. But don't you know from tests how the process described in the patent in suit works?

THE COURT: In that respect?

MR. WILLIAMS: In that respect.

A. I know that whenever I have carried out the opera-

tion of agitation froth flotation with a soluble substance, there has been material adsorbed out of solution onto the solid particles, that constituted a more or less complete coating upon the solid particles, yes.

XQ. 397. Did you ever try to use your solution again without adding any more frothing agent?

A. With the solution drained off, oh, yes, I have done that. It does not take very much reagent in comparison to the amounts that are used, in order to get a coating on the particles.

XQ. 398. So that you can use the same solution over again, without adding more frothing agent and get a froth?

A. Get a froth, yes. You cannot use this stuff indefinitely, by any means. There is a certain amount taken out every time, and if you started with the minimum amount that will produce the result that you require, then you have got to add some more reagent for the next test. The stuff does not last on indefinitely. You have taken it out on the mineral.

XQ. 399. And you have taken out some water, too, have you not, with your froth?

A. Very little. You can filter the water off the froth and get that back in. You have still got to add more frothing agent for your next test.

XQ. 400. Is that your experience?

A. Absolutely. I have tested that out quite carefully.

XQ. 401. With what mineral-frothing agents?

A. Well, amyl acetate, as I recollect, because that was one of the agents of the patent in suit that we could make work, and cresol, I think, was the other. Those are the only two that we could get any really good flotation results with.

XQ. 402. And what ore?

A. We worked with Butte and Superior ore, which is a zinc ore, and with one or two copper ores, I have forgotten which, Miami copper ore for one—I do not know. I have several other copper ores around the laboratory, and I think some of them were used at one time.

XQ. 403. Porphyries?

A. We were having considerable difficulty in getting good flotation results, and we had to fish around more or less among the copper ores, in attempting to get one that would give good results with a small amount of the substance.

MR. WILLIAMS: If we can suspend now, I probably am through, but I would like to talk with my colleagues, your Honor.

THE COURT: How long a time will you require in re-direct, Mr. Davis?

MR. DAVIS: I have only two questions and they will take about five minutes.

THE COURT: We are practically through with this witness in a few minutes more.

MR. WILLIAMS: A few minutes more, and possibly no more.

THE COURT: Very well, we will recess until two o'clock.

AFTER RECESS.

XQ. 404. Have you now the dimensions that I asked for this morning, and if so, will you please read them?

A. I have the dimensions of the vertical bladed impeller, which are as follows: Blades one-half inch wide, that is up and down, one-quarter inch thick, and about 1⅛ inches long each. The shaft is three-quarter inch in diameter, making the dimensions from tip to tip of opposite blades, slightly over three inches. The 45-degree blades are of substantially the same dimensions, except that they are turned 45 degrees to the vertical plane, instead of being in the vertical plane.

XQ. 405. And the interior dimensions of the vessel in which they rotated, have you that?

A. Four by four, I gave, by some twelve to fourteen inches high.

XQ. 406. Did you locate the opening in these blades through which you measured the vacuum that you produced?

A. That is about one-eighth inch from the end of the blade and is one of the four blades only.

XQ. 407. And how big an opening?

A. About one-sixteenth inch diameter.

XQ. 408. Round?

A. Round.

XQ. 409. Did you participate in the preparation of a paper entitled "Surface Tension and Adsorption Phenomena in Flotation," by Arthur Fay Taggart and A. M. Gaudin, issued with "Mining and Metallurgy" of August, 1922, for the San Francisco meeting of 1922 of the American Institute of Mining & Metallurgical Engineers?

A. I did.

XQ. 410. And the document that I have before me, is that the paper that was thus jointly prepared?

A. Yes.

XQ. 411. Before reading an extract from that paper, I would just like you to give a few definitions. What is galena?

A. Lead sulphide.

XQ. 412. That is the sulphide of lead that is recovered in the flotation operations of treating ores containing lead, is it not?

A. Yes.

XQ. 413. Now, tar acid, I think you have defined as a material that is soluble in the portions used in flotation. That is right, is it not?

A. Well, I think that is a correct statement. I do not think I defined tar acid.

XQ. 414. Have you performed an experiment and did you describe that experiment in this paper, as follows:

> "After adsorbing a tar acid onto two 500-gm. lots of galena, in the one case below 200 mesh, in the other between 200 and 100, the solid was drained by suction filtration and then placed in a Janney laboratory flotation machine with about 1500 cc. of water and agitated at 2200 r. p. m. No froth at all was produced. Yet the amount of adsorbed oil present produced an appreciable

froth when added anew even without a solid material to enhance the viscosity."

Have I read that correctly?

A. Perfectly.

MR. WILLIAMS: Cross-examination closed.

RE-DIRECT EXAMINATION.

By MR. DAVIS:

RDQ. 415. Professor Taggart, this article that you published in 1916 correctly represented your views at that time?

A. Yes.

RDQ. 416. That was true also of the testimony that you gave in the Butte case?

A. Certainly.

RDQ. 417. And this 1922 article, that Mr. Williams has just referred to?

A. Yes, of course; that was subsequent to the Butte case.

RDQ. 418. In so far as the views expressed by you here differ, if they differ at all, from the views on the same subject expressed in 1916 and 1917, what is that difference based on?

A. The 1916 statements represent my beliefs at a time when I had studied the flotation processes for something like a year, I think, in the laboratory, and represent accurately what I thought then, and they represent also the plausible thing. That is, you see the bubbles go into the pulp, and you see them come up to the top laden with mineral, and the plausible thing is that they have just coursed around in the pulp and picked up the mineral.

In 1919 I first saw a pneumatic apparatus working that had a glass side so that the actual operation could be seen through this glass side. It was a very short time after I had seen that that it became clearly apparent that what was going on there was distinctly different from that that was going on in the agitation machine, because in the cell you can make by eye these analyses that we made chemically. That is, you can see that the color is precisely the same in the pneumatic machine at the pulp level as is that of the pulp,

and that it gradually gets darker as you go up and that in the agitation machine the bubbles come out black, finished.

RDQ. 419. Have you published your views on that subject of pulp body and bubble-column flotation?

A. Yes, I have. I published a book on flotation processes that presents these views, about a year and a half ago, and that book was in press for about a year, and then early in January of this year I set forth some experimental data upon which the distinction is based, in an article published in the Engineering & Mining Journal in this country.

RDQ. 420. This book entitled "Manual of Flotation Processes," by Arthur F. Taggart, published by John Wylie & Sons, Incorporated, in 1921, is the book that you refer to?

A. Yes.

MR. DAVIS: I offer this book in evidence as Defendant's Exhibit No. 108.

MR. GARRISON: We object to that, if your Honor please. We do not see how that book can properly be admitted in evidence here.

THE COURT: What is your theory for that?

MR. DAVIS: The theory of that, if your Honor please, is this: They have marked one of Prof. Taggart's articles for identification; of course, they have not offered it in evidence, so I have not been able to object to it. If it does go in evidence I think we ought also to have in evidence the later publication of the same kind.

MR. GARRISON: Which article have you reference to, Mr. Davis?

MR. DAVIS: The 1916 article.

MR. WILLIAMS: We do not propose to offer it in evidence.

THE COURT: They read certain extracts of that to him and asked him whether those were his views at that time.

MR. DAVIS: If they do not propose to offer it in evidence——

THE COURT: And that was quite proper; and this is supplemental of his views at this time, this book?

MR. DAVIS: I agree to that, if they are not going to put that in evidence, that this need not go in.

THE COURT: All right.

RDQ. 421. Mr. Williams brought out this morning, in his cross-examination, that in these sampling tests that you made at Magma, at the feed end of the cell there was a space where there was no body of pulp underneath the bubble column at all; is that right?

A. Yes.

RDQ. 422. And was separation effected at that part of the cell?

A. Yes.

RDQ. 423. To what degree?

A. We did not measure at that particular place. My experience on some other measurements is to the effect that 75 to 80 per cent. of the separation in a pneumatic cell is made within the first couple of feet of length of the cell.

RDQ. 424. And does that occur whether there was a pulp-body underneath the bubble column at this place or not?

A. The appearance indicates that it does, and a cell can be operated perfectly well without any pulp body in it, with merely the bubble column.

RDQ. 425. Mr. Williams read from the article of 1922 a description of an experiment that you made. Will you please state what the purpose of that experiment was and what it indicated?

A. It indicated that the soluble agent that was adsorbed on the mineral was held there by the mineral and would not come off of the mineral into the water to give the necessary modification of the surface tension of the water to allow for the formation of a froth while, if we put into the machine an equal amount of the soluble material to that that was adsorbed onto the solid matter, then frothing was easily obtained; that is, the second part of the experiment was just to show that if we could have gotten the material that was adsorbed on to the sulphides off, there was enough of it there to froth.

RDQ. 426. And, as I understand, the experiments showed that after the first treatment and the filtration of the concentrate, you could not wash off the oil which had coated the mineral particles with water; is that correct?

A. Yes, and that was a soluble material.

RE-CROSS-EXAMINATION.

By MR. WILLIAMS:

RXQ. 427. You said in re-direct that a cell could be operated without any pulp-body in it. Was that based upon experience in mill operations?

A. Yes.

RXQ. 428. You did that in mill operations?

A. Yes.

RXQ. 429. Where and when?

A. At the Miami Copper Company, following the time there in 1919 when I discovered the way that the bubble column process worked. It was quite a natural development from that discovery, because I said if that is the way in which concentration acts, and if whatever little movement there may be in the body of the pulp has nothing to do with the concentration, as I suspect to be the case, then we can cut that part right out of the operation entirely, and the whole of the concentration should take place right in the bubble column. Therefore, I instructed them that they make a trough of about ten or twelve feet long, twelve inches wide, with porous bottom, put a baffle at the end to keep the froth from just flowing right on through, and then operate the thing which they did, and we got results that were the same as were being obtained in the regular pneumatic cells running in parallel with them.

RXQ. 430. What did you make your bubble column from?

A. Pulp that flowed into the head of the cell continuously.

RXQ. 431. And was that an ore-pulp?

A. Certainly, the regular ore-pulp that was going through the mill machines.

RXQ. 432. And that pulp went through the mill machine?

A. Well, the pulp—there was tailing discharged from the end of the machine. We had a glass side in it so we could see in, and there was not any body of pulp in it, only a little bit of sand, coarse sand, right in the corners, where the glass side did not come right over the blanket, but it was apparent that there was just perhaps this half-inch of sand there in the corner, and that was all.

RXQ. 433. But you mean that that cell was operating without pulp flowing in through along the bottom?

A. Absolutely, yes, sir, nothing in there by the bubble column.

RXQ. 434. You started with ore-pulp, you formed your bubble column out of that ore-pulp, didn't you?

A. We just turned the air on the machine and then started the pulp flowing into the head end of it.

RXQ. 435. And that pulp flowed in and it had to be there to form the bubble column, did it not?

A. It immediately forms the bubble column as soon as it gets onto the blanket.

RXQ. 436. About how long did you operate that?

A. That one for several months.

RXQ. 437. Several months?

A. Yes.

RXQ. 438. And did you test your recoveries?

A. Right straight ahead against the mill. They varied a little either way. That is my recollection of it.

RXQ. 439. And is that still being used?

A. No.

RXQ. 440. Merely an experiment?

A. It was merely an experimental apparatus pure and simple, just to check out this particular conclusion and emphasize and prove it.

RXQ. 441. That is to say if you did not have a pulp-body, you could separate in the bubble column, that is about the conclusion?

A. Make it in the bubble column. In other words, to prove conclusively the original statement that movement of

the bubble in the pulp and any movement or circulation of bubbles through the pulp are utterly unessential to the operation of the bubble column machine.

RXQ. 442. I wanted to call attention to a small matter in the record in the former case which I omitted, at page 1754, XQ. 237, and it follows quite closely after what I have read before:

"XQ. 237. Now, in your article, of which I read portions to you; in case No. 2, sulphide gangue, water, oil and acid. You say 'The addition of the acid has the two-fold effect of further lowering the surface tension and decreasin the adhesion ratio.' That is true, is it not?

A. True reading, yes. I have learned more since that was written.

XQ. 238. That was a mistake?

A. That was a mistake. It will be noticed, I think, if you look at the paper, that the lowering of the surface tension by the acid—if you will recollect the experiment here, the question of lowering of the surface tension has not been emphasized as the stabilizing of the froth.

THE COURT: I suppose your science is like law, always something to learn?

A. Yes, exactly, and this is rather a new branch."

Did you so testify?

A. I did.

MR. WILLIAMS: That is all.

RALPH B. YERXA was called as a witness on behalf of the defendants, and after having been previously duly sworn, testified as follows:

DIRECT EXAMINATION.

BY MR. DAVIS:

Q. 1. What has been your technical education, Mr. Yerxa?

A. I was graduated from the Massachusetts Institute of Technology in 1903 in mining and metallurgy. Since that time

I have done metallurgical work, and from 1908 through 1922 I was employed by the Miami Copper Company as metallurgist.

Q. 2. So employed, did you have charge of a flotation mill?

A. Yes.

Q. 3. How long?

A. From the time that it was installed in 1914 until about the middle of 1918.

Q. 4. And that was the mill, the operations of which were charged to be an infringement in the suit in the Third Circuit against the Miami Copper Company?

A. Yes.

Q. 5. You were one of the party that went to Superior, Arizona, for the inspection of the Magma Copper Company's mill?

A. I was.

Q. 6. Did you take any part in those sampling tests that Professor Taggart has spoken of?

A. Yes.

Q. 7. What part?

A. I was stationed on a platform somewhat below the vertical row of sampling pipes, and I attended to the hoses which connected the sampling pipes with the various receptacles, and I saw that the proper pipes were put in the proper receptacles.

Q. 8. What was done with the material that went through the pipes?

A. After the samples were taken, you mean?

Q. 9. Yes.

A. I turned those samples over, just as they were, to Mr. Perkins and Mr. Wilding.

Q. 10. Have you ever made similar sampling tests on a Callow cell of the specific type shown in these blue prints accompanying the stipulation in this case?

A. Yes, I have.

Q. 11. Where?

A. At the mill of the Miami Copper Company.

Q. 12. You checked up and are familiar with the results of the tests at Magma?

A. Yes.

Q. 13. Did they correspond or not with the results that you had had on the similar tests at Miami?

A. They corresponded.

Q. 14. Did you ever make any tests of the pulp density of the samples that were taken off in such sampling tests?

A. Yes, I have.

Q. 15. Where was that?

A. At the Miami Copper Company's mill.

Q. 16. Did you ever make any such sampling tests of the body of froth which rises to the surface of the spitzkasten in a Mineral Separation machine?

A. Yes, I have as to copper content. I do not recall now as I ever did as to density.

Q. 17. Have you drawings of the Callow cell and the Mineral Separation machine on which these tests were made at Miami?

A. Yes, I have.

Q. 18. Please produce them.

A. I produce a drawing, entitled "Glass Side Callow cell No. 1, Section 2-B, showing pipes for sorting tests, Drawing G, 133."

MR. DAVIS: I offer this blue print in evidence as Defendant's Exhibit No. 108.

MR. WILLIAMS: No objection.

(Received in evidence and marked "Defendant's Ex. No. 108. Miami Sorting Test Blue Print.")

Q. 19. Where are the sampling pipes shown on that blue print, and how are they identified?

A. The sampling pipes are shown at a point near the center of the cell, and are identified by the numbers 1 to 10, inclusive.

Q. 20. Now, will you please produce a drawing of the Minerals Separation machine?

A. The drawing I produce only includes the spitzkasten of the Minerals Separation machine. It is entitled "Arrange-

ment for Sorting Samples Minerals Separation Machine, Sketch No. 442."

MR. DAVIS: I offer that in evidence as Defendant's Exhibit No. 109, "Arrangement for Sorting Test M. S. Machine."

(Received in evidence and marked "Defendant's Ex. No. 109.")

Q. 21. Are the sampling pipes similarly indicated on that, numbered 1 to 15?

A. Yes.

Q. 22. Have you any sheets of data showing the results of tests made with those pieces of apparatus?

A. Yes, I have.

Q. 23. Will you please produce them?

A. I produce a tabulation entitled "Sorting Tests in Callow cell, drawing G, 133."

MR. DAVIS: I offer this sheet in evidence as Exhibit 110, in preference to reading it on the record. It will save time. Our point will be that it shows the same results.

MR. WILLIAMS: No objections.

(Received in evidence and marked "Defendant's Ex. No. 110, "Sorting Tests in Callow Cell.")

Q. 24. Now, will you please produce a sheet of the Minerals Separation machine results?

A. Yes, I produce a sheet marked "Sorting Test on Minerals Separation Machine Treating Primary Flotation Feed, Sketch 442."

MR. DAVIS: I offer that sheet in evidence as Exhibit No. 111.

(Received in evidence and marked "Defendant's Ex. No. 111, "Sorting Tests on M. S. Machine.")

Q. 25. Have you a sheet of the results of the pulp density tests?

A. The pulp density is shown on the sheet "Sorting Test in the Callow cell, drawing G, 133."

Q. 26. That is, the pulp density is shown under the columns headed "per cent. solids"?

A. Yes.

Q. 27. Does this sheet, Defendant's Exhibit No. 111, show the result of two different tests?

A. Yes, it does.

Q. 28. About when were those tests made, do you know?

A. Some time in 1920.

Q. 29. On this sheet, Defendant's Exhibit No. 110, what do the legends: "Primary Flotation Feed," "Secondary Flotation Feed" and "Primary Rougher Concentrate" mean?

A. Primary flotation feed in the Miami mill was the entire crude ore ground through 48-mesh. The secondary flotation feed was the ore after it had received prior flotation treatment. The primary rougher concentrate was the rough concentrates obtained at the cells treating the primary flotation feed.

Q. 30. Does your experience indicate to you what effect the variation of the depth of the pulp-body beneath the bubble column in the pneumatic process has upon the concentration by that process?

A. Yes.

Q. 31. What effect does it have?

A. It has none.

Q. 32. Will you please state some experience of your own that shows that to you?

A. Yes. In 1916, I believe it was, I increased the depth of pulp in a Callow cell by two feet, thereby more than doubling the volume of pulp in the cell, and I operated this Callow cell with the greater volume in competition with a standard Callow cell running alongside of it and having the same blanket (porous bottom) area, and found that the results were exactly the same in the two machines.

Q. 33. Where did you do this?

A. In the mill of the Miami Copper Company.

Q. 34. For what purpose was it done?

A. My purpose was to endeavor to improve the results. The results at that time had fallen off, for some reason, and I thought by increasing the length of time of the pulp in the cell that I could improve the results; but I found that I could not do so by that means.

Q. 35. That was at a time when you were manager of the mill, or metallurgist of the mill?

A. I was then metallurgist and assistant superintendent.

Q. 36. You heard Professor Taggart's testimony this afternoon about the experimental use of a shallow cell at Miami.

A. Yes.

Q. 37. Were you at Miami during that use?

A. Yes, I was.

Q. 38. And for how long a period was that shallow cell run?

A. For a period of two months continuously; that is, twenty-four hours each day for a period of two months and previous to that time for several periods of weeks at a time.

Q. 39. During this period of two months, was it run in competition with other cells?

A. Yes.

Q. 40. In what way?

A. The cell was situated nearby the rougher cells which treated the primary flotation feed and it was fed with the same pulp or the same character of pulp that these rougher cells received, so that the results obtained were directly comparable.

Q. 41. Was this cell operated by the regular operators of the mill?

A. Yes, it was.

Q. 42. Just like all the other cells?

A. Yes.

Q. 43. Did you ever make any investigation of the amount of circulating currents that there are in these pneumatic cells?

A. Yes, I have.

Q. 44. Where?

A. The mill of the Miami Copper Company.

Q. 45. What type of cell?

A. I made measurements on the Standard Callow cell and also on the cell of a little different measurement, a longer and wider cell, which we called there the "Miami type."

Q. 46. The standard Callow cell is the type of cell that

is shown in the blue print attached to the stipulation in this case?

A. Yes.

Q. 47. How did you make those measurements?

A. I made those measurements by means of a dynamometer, which was in this case a vertical rod suspended at the top, and having at the bottom a disc four inches square; at the top also and at right angles to the disc I attached an arm which carried a spirit level; the purpose of the level was to ascertain when the rod was vertical. The rod with its attached disc was placed in the cell at various points and the tendency of the disc to move the rod out of the vertical was measured by means of a spring balance. By this means the pressure on the disc could be calculated, and from this pressure determination it was possible to calculate the velocity.

Q. 48. How was this instrument used in the actual measurement of velocity in the cell, and what were the results? When I say, How was it used, Mr. Yerxa, I mean was it put in one place or in many places?

A. It was put in many different places and there were many different determinations made in the same place, for the reason that from hour to hour the direction of the currents changed.

Q. 49. What were the results?

A. I made measurements under three different conditions, with water alone in one cell, with water and pine-oil added to it, and with the pulp-flow as in our regular operations at that time; and I found that the maximum currents had the least velocity when the pulp was present as in our regular operations. This maximum velocity is one and a half feet per second at the tailing end of the cell, and 0.9 feet per second at the head end of the cell. The intermediate velocities are either zero or fluctuated first one way and then the other, to such an extent that I was unable to measure them.

Q. 50. You were reading those velocities from a chart, Mr. Yerxa; what is the chart?

A. The chart is entitled "Dynamometer Measurements of Currents in Lower Cell, Section 2-B No. 1, Pulp and Oil Feed at normal rate. Air valves remain unchanged from previous day. Observations made at Miami by R. B. Yerxa and W. Shelshear, January 21, 1921." The expression "Air valves remain unchanged from previous day" refers to the measurements made on January 20, 1921, when the solids were absent from the pulp, but pine-oil was present.

Q. 51. What do the small arrows indicate, and the figures?

A. The arrows indicate the direction of the currents at the point where the arrows appear; while the figures are the number of feet per second.

MR. DAVIS: I offer this chart in evidence as Defendant's Exhibit No. 112.

MR. WILLIAMS: No objection.

(Received in evidence and marked "Defendant's Exhibit No. 112.—Chart of Velocity Tests by Yerxa.")

Q. 52. Did you see, during the inspection at Magma, any part of the velocity tests that were made by representatives of the plaintiff there?

A. Yes. I did not, however, see the marks on the tape which recorded the number of revolutions of the impeller.

Q. 53. What part of the operation did you see?

A. I accompanied Mr. Wilkinson, who was placing the instrument in various parts of the rougher cell and in the cleaner cell, my idea being to note the exact spots where the measurements were being made.

Q. 54. And you did note those spots and see him put it in various places in the rougher cell and in the cleaner cell?

A. Yes.

Q. 55. Who devised the type of dynamometer that you used in your tests at Miami, and for what purpose?

A. Dr. Irving Langmuir suggested this form of apparatus for the particular purpose of measuring these currents in the pneumatic cells.

Q. 56. Have you seen one of these Callow laboratory-

type machines, such as was described by Mr. Wilding as being present in the demonstration plant in Boston?

A. Yes, I have.

Q. 57. And you heard what Professor Taggart said about the larger dead space at the end of the cell?

A. Yes.

Q. 58. Have you ever seen any experiments to indicate whether that larger dead space does or does not affect the velocity of the circulating currents in the cell?

A. Yes, I have. It does affect the currents.

Q. 59. What was the experiment that you saw?

A. The experiment consisted of placing a board down into the water in such a way as to eliminate the effect of this dead space.

Q. 60. And what effect did that have on the current?

A. That materially reduced the current and entirely cut out the general circulating current.

Q. 61. In the two experiments, the results of which are listed on Defendant's Exhibit No. 110 in the column showing the per cent. of solids, it appears that the per cent. of solids taken out through the sampling pipes at the bottom of the cells, was in both cases greater than the per cent. of solids taken out by the pipes from the upper portion of the pulp-body, does it not?

A. Yes.

Q. 62. Does that indicate anything to you with regard to the extent and velocity of movements in the body of the pulp?

A. Yes, it does, because it shows that the movements in the pneumatic cell are insufficient to keep the solids in the pulp in uniform suspension. If the solids in the pulp were in uniform suspension the per cent. solids from sample No. 1, up to the top of the pulp, would be substantially the same, within the limits of error of the determination of the per cent. solids.

Q. 63. Was this dynamometer you used sensitive enough to measure the velocity of the pulp in the cell which would be due to the flow of the pulp through the cell?

A. No.

Q. 64. What is the order of that velocity, roughly?

A. It is less than one foot a minute.

Q. 65. Less than one foot a minute?

A. Yes.

MR. DAVIS: That is all.

CROSS-EXAMINATION.

By MR. WILLIAMS:

XQ. 66. You said that by using a deeper cell you increased the length of time that the pulp remained in the cell. That of course is correct, is it not?

A. Yes.

XQ. 67. Now, what cell was it that this was compared with?

A. It was a standard Callow cell.

XQ. 68. Of substantially the type of the blue print annexed to the stipulation?

A. Yes.

XQ. 69. And when you deepened it, how did you bring that about?

A. I placed two 12-inch boards all the way around. That is, I built up the sides of the cell and took off the float valve mechanism and placed it on the top.

XQ. 70. You built up all of the walls of the cell so as to make it higher?

A. Yes.

XQ. 71. Now, what was the normal length of time of the pulp in that cell before you made the change, roughly?

A. Figuring ten cubic feet of pulp per minute, and the volume of the pulp in the cell at one time at thirty-two cubic feet, would give three minutes as the average time.

XQ. 72. And then when you increased, about what did you increase it to?

A. I figure that I doubled the volume, which would double the time in the cell.

XQ. 73. What was the previous treatment of that pulp before it reached that cell?

A. The pulp had been partly impoverished of mineral

by means of gravity concentration, and then proceeded by the ordinary means, after the addition of oil, to the pneumatic cells.

XQ. 74. And what was the ordinary means?

A. Launders and elevators.

XQ. 75. Launders and elevators?

A. Yes.

XQ. 76. No grinding mill?

A. Well, the grinding mill was previous to the point where I started.

XQ. 77. Well, there was a grinding mill at the head, was there not?

A. Not at this time.

XQ. 78. So that the previous treatment was the addition of the oil, launders and elevator, and then flowing into the cell?

A. Yes.

XQ. 79. Now, in the instance of this shallow cell, what was the previous treatment of the pulp before it entered that shallow cell?

A. In this case the crude ore was treated, and the ore, after being crushed to three-fourths of an inch, was ground in Hardinge mills, in closed circuit with Dorr classifiers to 48-mesh. That minus 48-mesh material was sent to the primary rougher cells, and a portion of it was sent to this shallow cell.

XQ. 80. Where was the oil put in?

A. The oil was added in part at a point ahead of the Hardinge mill, and in part to the classifier overflow—that is, to the pulp, after it left the classifiers on its way to the pneumatic cells.

XQ. 81. In launders on its way to the pneumatic cells?

A. Yes.

XQ. 82. And what oil was put in, in advance of the grinding mill?

A. It was a creosote oil. I do not recall now what the trade name of it was, Reilly 19, perhaps.

XQ. 83. What proportion of the total amount of oil used was put in at the head of the grinding mill?

A. About 90 per cent.

XQ. 84. Then the 10 per cent. of oil that was put in, in the feed to the Callow cell—feed launder to the Callow cell, what oil was that?

A. Pine oil.

XQ. 85. Now this shallow cell, what is your view as to whether or not there was any pulp flowing along the bottom of it?

A. I think there was a trickle of what I would call pulp flowing along the bottom. I never was able to see any pulp through the glass sides. The bubble column apparently came right down to the blanket.

XQ. 86. What was the rate of feed of the pulp to that cell?

A. It was, I believe, about thirty-five tons a day of twenty-four hours. I proportioned it, so that it would have the same number of tons per square foot of blanket area as the primary rougher cells in use in the same section.

XQ. 87. Now you said that in your measurements of velocity with a dynamometer that the velocity of the currents was changed to some extent by the different operations of just plain water; oil and water; ore pulp and oil. Did you make any determinations of the differences between those conditions?

A. Yes. It is not so very marked with water only. While there is not any great increase in the maximum velocity, in the case of water only there seemed to be more places that were measured that showed movement.

XQ. 88. Now, take the other condition of water plus pine oil.

A. The number of places there that showed movement were greater than in the case of the pulp.

XQ. 89. Now, may I have these two sheets that you have produced, showing water plus pine oil and water only?

A. Yes.

MR. WILLIAMS: I ask that these be marked for identification.

(Marked "Plaintiff's Exs. B and C for Identification.")

XQ. 90. They are the same kind of records, I take it, as the one that was offered in evidence?

A. Yes.

XQ. 91. Will you give us the formula that you used for your dynamometer calculations?

A. Yes, I used the formula $v=\sqrt{2gh}$.

XQ. 92. In this standard Callow cell, what is the effect on the pulp of cutting off the air supply as to sedimentation; would the speed of movement of the pulp through the cell carry the pulp along without sedimentation, or what?

A. The sands tend to build up at the bottom, if the air is cut off.

XQ. 93. The air maintains a condition which tends to prevent sedimentation, does it not?

A. Yes.

XQ. 94. And in a spitzkasten, the bottom is so acutely sloped that there will be no sedimentation in the spitzkasten; is not that the general rule among metallurgists?

A. Yes.

XQ. 95. In regard to this matter of the dead space in the five-ton Callow pneumatic cell, can you describe to me, having before you the sectional views of that cell, that are in evidence, the location of the board that you spoke of, to diminish the effect of the dead space; where was it located, how far up did it extend?

A. The board was placed vertically in the cell at a point just to the left of the discharge opening marked "R" looking at the longitudinal vertical section. The board was not wide enough to occupy the entire width of the cell, so that the dead space could not be completely cut off.

XQ. 96. How far up did the board extend?

A. The board extended up above the top of the cell, as I recall.

XQ. 97. Above even the froth level?

A. Yes. However, the same effect, I think, would have been observed had it only extended to the top of the liquid.

XQ. 98. Then the escape of the water through the tailings outlet had to be through the narrow space on each side of the board between the walls of the cell and the board; is that right?

A. Yes, that is right.

XQ. 99. And was this cell in which you saw this experiment carried on, one provided with glass sides?

A. Yes, that experiment was carried on at the Philadelphia plant of the plaintiff.

XQ. 100. In the glass cells of the plaintiff's demonstration plant in Philadelphia?

A. Yes.

XQ. 101. In relation to the Miami case?

A. Yes.

XQ. 102. Mr. Yerxa, Mr. Kenyon has noted your figures, that the speed of the movement of the pulp through the Callow cell was of the order of one foot per minute; and how long was this standard Callow cell interior dimension, excluding the feed compartment—the length of the cell, please?

A. Will you just repeat the question? A. (Question repeated as recorded.) The cell to which I referred there was a standard Callow cell.

XQ. 103. Nine feet?

A. Eight feet six inches, I believe, inside dimension.

XQ. 104. Then you said it took about three minutes for the pulp to go through the cell; is that right?

A. That is entirely approximate.

XQ. 105. Should it not be eight minutes and a half, according to those figures?

A. The first measurement that I gave there of one foot per minute, I think it was entirely approximate.

XQ. 106. Yes.

A. Well, I took some care here to figure the time out.

XQ. 107. So that you wish me to take it that the time

of three minutes is the time required for a single cubic inch of pulp to go through the cell is very nearly right?

A. Is very nearly right for the conditions then at the Miami Copper Company's mill.

XQ. 108. And that the other one foot per minute is just a rough guess?

MR. DAVIS: What he said was, Mr. Williams, that it was not more than one foot per minute.

A. I think I said, or less than one foot per minute.

(Witness excused.)

LEVI B. SHIPLEY, called as a witness on behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. NEARY:

Q. 1. What is your present occupation, Mr. Shipley?

A. I am associated with the Bernuth-Lembcke Company, of New York and London.

Q. 2. What is their business?

A. They are merchants in creosote oil and coal-tar products, imported materials chiefly.

Q. 3. What has been your education, Mr. Shipley?

A. I am a graduate of the University of California, College of Chemistry in 1910, degree of Bachelor of Science.

Q. 4. What practical engineering experience have you had, if any?

A. Chemical engineering experience, do you mean?

Q. 5. Yes; any sort of engineering experience.

A. I was chemist for the Western Sugar Refining Company, of San Francisco, and in 1912 I entered the employ of the Barrett Company, in New York City.

Q. 6. What is the Barrett Company?

A. Coal tar distillers.

Q. 7. How long did you remain with them?

A. I was with them from 1912 until 1919.

Q. 8. What were your duties while with the Barrett Company?

A. I was a chemist in the research department, and became their technical representative on creosote oils.

Q. 9. Did the Barrett Company deal in flotation oils.

A. They did.

Q. 10. Largely?

A. Very largely.

Q. 11. When did you leave the Barrett Company?

A. At the beginning of 1919.

Q. 12. And you went then with the Bernuth-Lembcke Company?

A. With the Bernuth-Lembcke Company.

Q. 13. How long were you with the Bernuth-Lembcke Company?

A. I am with them at the present time.

Q. 14. Will you give a little more detailed statement of the business of the Bernuth-Lembcke Company?

A. The Bernuth-Lembcke Company are merchants in the handling of creosote oil and coal-tar products. Their main business is the importation of creosote oil in tank-steamer lots from Europe into this country. The creosote oil being used chiefly for wood-preserving purposes and more recently we are using certain of the grades of creosote oil for the flotation industry or in the flotation field.

Q. 15. Have you or the Bernuth-Lembcke Company or you and the Bernuth-Lembcke Company jointly any arrangements with any English or Scotch firm in relation to the importation of any oils in this country?

A. We have.

Q. 16. What English firm?

A. Scotch firm of Shields & Ramsay, Limited, of Glasgow, Scotland.

Q. 17. Mr. Shipley, are you familiar with the publication appearing in the Engineering & Mining Journal of May 11, 1907, describing the Elmore Vacuum process in which a reference is made to blast furnace oils?

A. I am.

Q. 18. What, in your opinion, do the words "blast furnace oils" refer to in that publication?

A. Blast furnace oils, as I take it, refers to the creosote oil obtained upon the distillation of blast furnace coal tar.

Q. 19. Has the name "blast furnace oil" any distinctive meaning in relation to particular oil and the source of supply of that oil?

A. It has.

Q. 20. Will you explain just what that is?

A. Well, I think I might better explain it by saying that there are several different grades of coal tars. In general where they are differentiated, they are separated into groups as to their source. That is, we have the coal tars which are obtained from the gas works where they are making gas tar, I mean coal-gas tar; and we have the coal tar which is made or recovered in the by-product coke ovens. Now, those two are the main source of coal tar. Now, in addition to that, we have the coal tar produced at the blast furnaces in Scotland. That is a rather unique or unusual proposition, because in Scotland they use the raw coal directly in their blast furnaces in making their pig iron, and that coal is coked within the blast furnace itself during the process of smelting or making the pig iron.

Q. 21. Will you explain briefly just how the blast furnace oil is produced from the blast furnace operation?

A. The blast furnace is charged with the iron ore, with the limestone, and the raw coal, which is a native coal of Scotland, generally termed splint coal. Now, sometimes they do use a little coke, but in general the bulk of their material is the splint coal of Scotland. In the top portion of the blast furnace that coal undergoes coking before it passes down into the mass of the furnace to serve its purpose in reducing the iron ore, and the volatile portions, given off from the coal, at the top portion of the furnace pass over through the green gas main. There this green gas is subjected to condensation, and the coal tar is separated from the gas, and along with it, that is in the same process, the ammonia, and so from the blast furnace operation we get the blast furnace coal tar. Now, that coal

tar is then taken into their stills, their tar stills, and separated into blast furnace tar oils and blast furnace tar pitch, and these are the two main products from the distillation of the blast furnace coal tar.

Q. 22. Do you or you and the Bernuth-Lembcke Company jointly import blast furnace oil into this country?

A. We do.

Q. 23. Just through what means do you get the blast furnace oil for importation in this country?

A. In Scotland there are approximately sixteen ironmasters at whose plants they are using the raw coal to make their pig iron. Now, these are distributed through more or less one center in Scotland, and at each plant they have their entire distilling apparatus, their stills. They make their oil and then that oil is collected in one central storage plant at Grangemouth, Scotland. Now, in the regular business of the Bernuth-Lembcke Company in creosote oils, we handle the creosote oil in tank steamer lots of about 10,000 tons at a time (two to three million gallons), and we load that blast furnace oil into separate tanks on our regular tank steamers and bring it into this country along with our regular creosote oils.

Q. 24. Mr. Shipley, do you know whether or not the source of production of blast furnace oil was the same in 1900, say, as it is today?

A. To all practical purposes it is practically the same today as is was in 1900—the general methods of operation.

Q. 25. The general methods of operation of the blast furnaces, and as well the condensation of the gases and the distillation of the tars has been the same through that period?

A. Yes, that is right.

Q. 26. How long has Bernuth-Lembcke Company been importing blast furnace oil into this country?

A. They have brought over certain quantities of it ever since, say, 1907, I mean even before 1907 Bernuth-Lembcke Company was bringing over quantities of blast furnace oils.

Q. 27. Is the blast furnace oil now imported into this country substantially the same substance as that imported into the United States in 1907?

A. As far as I can say, and that is following a rather careful study of the situation, I would say that the quality of blast furnace oils today is practically identical with that of 1907 and before.

Q. 28. If there is any change, in what would that change consist?

A. Well, it would consist more in the varying proportions of the different compounds in the oil, rather than in different kinds of compounds in the oil.

Q. 29. Would there be any more change between 1907, say, and today in the character of blast furnace oil than there would be in any two lots that you might get in the same shipment?

A. I would hardly expect any more change.

Q. 30. How do you distinguish between blast furnace oil and other coal-tar creosotes, if at all?

A. In the trade, you mean?

Q. 31. Yes.

A. Why, blast furnace oils are distinguished from ordinary coal-tar oils by the fact that they contain a very high percentage—that is, relatively a very high percentage—of the tar acids and the tar bases as compared with the oils from the usual run of coal tars.

Q. 32. Is blast furnace oil now used in large scale operations in flotation?

A. It is.

Q. 33. In this country?

A. In this country.

Q. 34. And in other countries?

A. And in other countries, to the best of my knowledge.

Q. 35. What are the tar acids of the blast furnace oil?

A. The tar acids of blast furnace oil or any tar oil—and by this I am referring to the general classification or term—represent the materials in the oil which are soluble in caustic soda, and which are recovered from the caustic soda solution upon the addition of acid.

Q. 36. And how would you designate those substances?

A. They in general pass under the designations of vari-

ous carbolic acids, phenols, cresols and the higher homologues of these different materials.

Q. 37. Has any of this oil been shipped by you and your associates in business to South America?

A. It has.

Q. 38. To what company?

A. The Braden Copper Company.

Q. 39. How did you first designate this oil when you were introducing it to the trade?

A. Why, we at the start called this material—I mean when I first started to develop the field for this blast furnace oil importation, we called it Bernuth-Lembcke flotation oil No. 1.

MR. NEARY: The direct examination is finished.

CROSS-EXAMINATION.

By MR. WILLIAMS:

XQ. 40. I did not quite understand you when you gave the year that you left the Barrett Company and went with the Bernuth-Lembcke Company.

A. I left the Barrett Company at the end of 1918, and shortly thereafter connected with the Bernuth-Lembcke Company. That was early in 1919.

XQ. 41. And when did you enter the employ of the Barrett Company?

A. In the year 1912.

XQ. 42. What was your occupation and where were you in the year 1907?

A. In the year 1907 I was in the employ of the Western Sugar Refining Company of San Francisco, and at the same time attending the University of California.

XQ. 43. And you entered the oil business in 1912?

A. In 1912.

XQ. 44. I notice that you used the term "blast furnace oils" in plural, and defendant's counsel used the term "blast furnace oil" in the singular. What to your mind is included today by the term "blast furnace oils" in the plural?

A. The only distinction I would make there is that blast

furnace oils are the oils as obtained at each and every one of those sixteen or seventeen different iron masters. Now in our trade we do not take the product from any one of those iron masters. We combine the product from them all, that is, according to business conditions; and then our product we would normally speak of as blast furnace oil. Now, I may have had that in mind when I put the plural on that.

XQ. 45. There are sixteen different sources of this blast furnace oil, is that right; I think that is what you said?

A. Well, I do not know whether you would call them "sources." I would not think of it as different sources.

XQ. 46. Well, sixteen different places at which they make blast furnace oil?

A. Well, that is right.

XQ. 47. And they do not make it all alike?

A. Well, in the trade we recognize that it is not exactly alike from any two. That is, the oils from any different plants are not absolutely identical. There are certain variations in the gravity and a few other points.

XQ. 48. And today you mix together those oils of the different manufacturers and call it one product; is that the idea?

A. Well, that is not it so much as that we made a study of the average grade for all the 16 or 17 plants, and then we figured they would have a certain amount of tar acids on the average, and so we maintain the quality of that oil as uniform as it is possible.

XQ. 49. And, of course, the tar acids are very desirable in the flotation art of today, are they not?

A. It appears to be so.

XQ. 50. Now, when was it that you started in direct connection with supplying the flotation art with these blast furnace oils?

A. Early in 1919 I personally was in that business.

XQ. 51. And the aim now is to see that you have a good supply of tar acids, is it not?

A. Well, I would say that is one aim, yes.

XQ. 52. Well, you could not sell that oil today without tar acids for flotation purposes?

A. We have sold some without tar acids for flotation.

XQ. 53. To be mixed with other oils?

A. Perhaps, we did not follow it up.

XQ. 54. You spoke of selling some blast furnace oils to the Braden Company. When was that, within your knowledge?

A. During the fall of 1922.

XQ. 55. Are you still selling it to them?

A. I personally am not selling that, but my principals are.

RE-DIRECT EXAMINATION.

BY MR. NEARY:

RDQ. 56. Mr. Shipley, have you made a visit to these various blast furnaces in Scotland or the sources of supply of blast furnace oil?

A. I have.

RDQ. 57. Is there any substantial difference in the method of production of the blast furnace oil as between the different plants?

A. They are different in production—I do not quite get the question. (Question repeated). No material difference to the best of my knowledge.

RDQ. 58. Have you made examinations of the products of the different plants with the idea of ascertaining the differences in the products?

A. I have.

RDQ. 59. In what does it differ principally?

A. The difference lies in this, that at any given plant the tar acid proportion of the oil is fairly uniform throughout the year, and for any given plant our tar acids, as I say at any given plant would be fairly uniform. Now we do not produce enough oil at any one plant to take care of the trade that we have in flotation, and hence it becomes necessary for us to distribute a uniform grade of blast furnace oil as far as the tar acids are concerned.

RDQ. 60. What is the range of difference in tar acids as between the various blast furnace oils that are produced at the different plants?

A. The average is about 25 per cent. of tar acids. The range at the minimum would be, say, somewhere around 22 per cent. and in some few cases up to as much as 35 per cent.

RDQ. 61. Is there any other difference except in so far as the difference in tar acids might produce a difference in the oil?

A. No material difference that I know of.

RE-CROSS-EXAMINATION.

BY MR. WILLIAMS:

RXQ. 62. When did you make this visit or those visits to these plants?

A. I went to Scotland at the end of the year 1920.

RXQ. 63. And that was the commencement of your actual contact with the work of those plants; is that right?

A. May I have that question again?

RXQ. 64. That was the commencement of your actual inspection of the work at those plants?

A. It was of my actual inspection but not of my actual knowledge.

RXQ. 65. Well, I think your view of knowledge is a little broader than mine.

A. Well, for the reason that in my study of tars and tar oils in my work at the Barrett Company it was very necessary that we make a very extensive study of all types of tars, and that work was done when I first went with the Barrett Company back in 1912, and at that time we procured samples of the blast furnace tar from Scotland and made rather elaborate series of tests of that tar with other tars, and it was based on that work that I went into the flotation business, that is, the furnishing of oils for flotation purposes, knowing where to get them and the general qualities of those oils.

RXQ. 66. So that work was based upon samples delivered to you as representing these different places in Scotland; is that right?

A. Yes, that work in 1912 was based on the samples obtained, authentic samples obtained.

By Mr. Neary:

RDQ. 67. Mr. Shipley, have you a sample of blast furnace oil with you?

A. I have in the city, but not right here with me.

RDQ. 68. Can you produce it later?

A. I can.

(Witness excused.)

Mr. Davis: I will call Dr. Bacon.

If the Court please, Dr. Bacon's testimony will have to do with the development of the defendant's reagent at the Mellon Institute.

Raymond F. Bacon, called as a witness on behalf of the Defendant, being first duly sworn, testified as follows:

Direct Examination.

By Mr. Davis:

Q. 1. What is your occupation, Dr. Bacon?

A. Consulting Chemist, New York City.

Q. 2. What is your general education and experience?

A. I was graduated in 1889 from the De Pauw University, a College in Indiana. I took a Master's Degree in Chemistry at the De Pauw University in 1900. I then taught chemistry for one year at a small college in Indiana. In 1901 I went to Chicago and did graduate work in chemistry in the University of Chicago, receiving a doctor's degree in 1904. I was then for one year in charge of a mine in Colorado. I then went as chemist for the Government to the East, and spent the next five years in the Far East, studying the chemistry of tropical resources, particularly oils, resins and things of that kind. I then came back to this country, in the Bureau of Chemistry, in 1910, where I was for one year. In 1911 I went to the University of Pittsburgh, to what was called the Department of Industrial Research of the University of Pittsburgh. Very shortly after I went there I was made Associate Director of that Department, and that very shortly became known as the Mellon Institute of Industrial Research of the University of Pittsburgh. In 1914, on the death of the Director, Dr. Duncan, I was made Director of that Institution,

and was Director of the Mellon Institute of Industrial Research of the University of Pittsburgh until the end of 1921, when I went to New York as a Consulting Chemist. In the war I had charge of the chemical work of our army in France, and received an army citation and a Distinguished Service Medal for my work in France. I have also received honorary degrees of Doctor of Science from two American universities.

Q. 3. While connected with the Mellon Institute of Industrial Research at Pittsburgh, did you have anything to do with a Fellowship established there by the Metals Recovery Company?

A. Yes, the Metals Recovery Company established a Fellowship on Flotation on July 1st, 1914, and I had general direction and charge of that Fellowship from the time of its establishment up to the time I left Mellon Institute, and since that time I have had some of the same men working in my own laboratories.

Q. 4. Will you describe what these Fellowships are, or what this Fellowship was?

A. The Mellon Institute of Industrial Research was founded with the general idea of trying to bring the learning of the University to the service of industry. The general form of the Fellowship was this — a company which had problems that it wanted to solve could place a sum of money with the Mellon Institute and the Mellon Institute would then hire competent chemists to study these subjects, and would give them every facility for the study of such subjects, and the results which were obtained from such study belonged to the company which had provided the funds for the Fellowship. That, very briefly, is the system.

Q. 5. And what was this particular Fellowship of the Metals Recovery Company on Flotation?

A. At the time this Fellowship was founded——

Q. 6. What time was that?

A. July 1, 1914.

Q. 7. Proceed.

A. At the time this Fellowship was founded we were informed by those who founded the Fellowship that while

flotation had been started in this country on certain types of ores, particularly zinc ores, that it was not possible to float the great body of ores in this country, that is, particularly the copper ores. The copper ores were from an economic standpoint the most valuable of the ores that might be amenable to flotation, and the subject of the Fellowship was to study flotation and find out its essence as far as we could, find out what types of oils were suitable for flotation; in fact, find out anything about it that would enable us to make an improved flotation more applicable, particularly to these large bodies of copper ores, although that was perhaps only the immediate point that was in view, because as the Fellowship went on the problem was to make improvements; to find better flotation agents or better methods of flotation and, in fact, to study the whole subject of flotation, so as to improve it in practice.

Q. 8. Now, in proceeding with the work under this Fellowship, will you tell us what was done?

A. I remember that we started out particularly with a study of the oils that were in use, because we were not so much interested in or we did not feel that it was so much our province to try to improve the process from a mechanical standpoint, as to improve it from what you might call the chemical standpoint, or if you please, the physical standpoint of getting better reagents to use or better conditions without regard to the actual apparatus in which the process might be carried out. I remember that one of the first things which we did, and in fact, this line of thought ran all through the Fellowship, was to study the properties of all the possible oils that had been proposed or that were possible to be used. We made determinations of almost every property that you could think of that we thought might have any relation to what made an ore float. The general idea, as in any scientific work, was to try to tie up flotation to properties which might be measured. Just as soon as you can tie up an industrial subject with things that can be measured, then it is possible to advance very rapidly, because we might have measurements of properties of many substances which are not used

in that industry, made by other workers, and if we knew what properties made an oil suitable for flotation, then it would be very easy to predict, or at least to make an intelligent guess as to what oils were suitable and we could thus pick out certain oils, and on that basis would be able to make advances that would enable us to obtain higher recoveries and cheaper work in the flotation process.

Q. 9. What sort of properties did you examine into?

A. I think we examined at different times almost every property you could think of. We did a great deal of work, of course, on the surface tension of these oils, and we examined their solubilities. We examined their viscosities, we examined them from the standpoint as to whether they were acid or alkaline, or neutral. We separated mixtures that were known to be flotation agents, into their different constituents, and then put those constituents together again in different proportions. We examined the subject, of course, from the standpoint of whether the substance should be a liquid or a solid or anything of that kind, and then we went further in this regard, too. We examined it from the standpoint of the chemical characteristics of the substances that went into flotation oils. I think I can explain that perhaps a little better in this way:—In other fields of investigation it has been found that the chemical constitutions, or as we say the arrangement of the atoms in the molecule, have enabled us to predict a great deal as to what compounds of that particular arrangement would be useful. For instance, in the field of dyes, after they had made a few of these organic dyes—synthetic dyes—they began to recognize that certain groupings made a substance a dye, and after that the way was pointed and the chemist could go ahead and make other compounds, that had not existed before, that had the same groupings, and it usually proved that if a substance had the same grouping, that substance was also a dye. The same thing has been applied in medicine. For instance, the substance called cocaine, which you are perhaps familiar with as a local anesthetic. Chemists had found that cocaine had a certain structure of the molecule, and they were able then to

make another substance which, having the same structure, also proved to have the same properties of forming local anesthesia. I simply illustrate this to show the line of thought that we had. We were in hopes that by studying many of these properties we could finally say that a substance is a flotation agent, because it has such and such a property, either a physical property or a chemical property, or even a combination of any of these, because if we could, then the advance would be very rapid.

Q. 10. Did you ever find a reliable criterion by which you could pre-determine whether a substance would be a flotation agent or not?

A. No, with our present state of knowledge we do not know at all. It does not make any difference.

Q. 11. The only way is to try it out?

A. Yes, that is really the only way to do, to try it out.

Q. 12. Now, you spoke of looking into the solubility. Did you find out what relation solubility had, if any, to flotation agents?

A. Yes, we considered that very carefully and we found this: — We found that all flotation agents, which were successful flotation agents, were partly or wholly soluble in water, in the proportions used. That is, there is no successful flotation agent which is not at least partially soluble in water, but I want to say this: that the question of whether a substance is soluble in water or partially soluble in water has nothing whatever to do with whether it is a good flotation agent.

Q. 13. That is, its usefulness as a flotation agent has no measurable relation to its solubility?

A. Solubility alone tells nothing about whether a substance is useful or not, assuming it is partially soluble, because I know of no flotation agent which is absolutely insoluble.

Q. 14. And you use that expression "absolutely insoluble" in the sense of insoluble at ordinary temperatures in the proportions in which it would be used in flotation?

A. Yes.

Q. 15. Can you give me any idea of the number of individual substances that you and your assistants examined in this way under that Fellowship?

A. We certainly examined—over a period of about nine years—several thousand substances; I don't know exactly how many. I know this:—that after we discovered alpha-naphthylamin, we thought there might be a class relationship, so we started in and investigated classes of compounds, not indiscriminately, and in that class investigation I remember we put down the number and we investigated about 256 classes of compounds.

Q. 16. Tell us about the discovery of X-cake—alpha-naphthylamin.

A. Alpha-naphthylamin was discovered in connection with a theory which we had at one time that the forces which were in play were electrical in their nature. I might say that investigators, as they go along usually get what we call theories, and the theory is sometimes useful to tie up to, and as soon as the facts don't tie up any more, then it is discarded and we get another theory. But at that time we were working on a thory that electrical forces were the forces, perhaps, which came into play and which caused flotation. We thought at that time that we had some evidence for that. We were using quite a number of substances which chemists say are ionized in such a way as to give strong positive ions in solutions. We were working on mixture of oils, which we had found were satisfactory at that particular point. We were adding various substances to these oils, using a standard oil mixture, and then adding certain substances to it systematically to see whether any of them had any beneficial effect in flotation. Among the substances added was alpha-naphthylamin and we noticed that when it was added to the oil it did increase the recovery quite pronouncedly. There were two or three other substances which, added to oil, did much the same thing. Right at that particular time we did not follow up that discovery, because there were other things that came in, and there was perhaps a period of three or four months before we followed that up thoroughly. When we

came back to follow it up, we of course followed the general line that we had thought of before. We took this oil mixture to pieces and tried the pieces, and among the pieces we tried alpha-naphthylamin alone, and we found that alpha-naphthylamin alone gave very good results, and that was the way that that particular thing was discovered.

Q. 17. About what date was that?

A. The first work that I spoke about, when we used it with oil, was about the middle of May, 1916, and the later work where we first used it with water alone was, I think, in November, 1916.

Q. 18. What sort of ores, do you remember, were you working with at that time? That is, zinc or copper ore?

A. They were copper ores. In fact, virtually all of the work that we did was on copper ores, because while we have done work on zinc ores, as a general rule it was on copper ores, because we were trying to float the hard ores. There are a great many zinc ores that are very easy to float, and I do not know that it is so necessary to find a very ideal reagent to float them.

Q. 19. Can you tell us what X-cake is? That is, Dr. Bacon, I want to know whether it is amyl acetate, or phenol, or a homologue of phenol, or valerianic, benzoic or lactic acid, or an acetone or ketone, such as camphor.

A. No, it is none of those substances, nor does it have any chemical relationship to any of those substances.

Q. 20. What does X-cake look like?

A. It is a crystalline solid. When purified it is a white crystalline solid.

Q. 21. Have you ever made any experiments to ascertain whether the mineral particles of an ore-pulp are coated with X-cake during the process of flotation where X-cake is used as a flotation agent?

A. Yes, we made lots of experiments of that kind. In fact, when we first discovered X-cake we were rather worried about the thing from the commercial standpoint, because our work indicated that it would require something like six-tenths of a pound per ton to treat the ore, and we wondered whether

it was not too expensive. So the first thing we asked ourselves was:—Where does this X-cake go? That is, you put some X-cake into solution in the water and you make a float, and it seemed to us that you ought to be able to return that circuit water and add extremely little more, or virtually no more, X-cake and make another float, and so on, and thus use very little. But we found that that was not the case. So immediately we said: Where does it go? And then we made a series of experiments to find out where it did go, and we found that the X-cake was adsorbed against the ore particles and principally against the mineral particles.

Q. 22. Was X-cake a substance which could be bought in the market in large quantities at that time, that is, was it a marketed substance?

A. Yes. I do not know how much was made in this country at that time, but it was made in this country at that time, there is no question about that.

Q. 23. Yes, but it was a known substance?

A. Yes. X-cake is used in the dye business, and the only reason for my remark is that the dye business was not then developed in this country to the same extent that it was during the war and is now.

Q. 24. What do you mean by "adsorption"?

A. Adsorption is the coming out of solution onto a solid surface or even onto a gas surface. That is, a substance which is in solution is not concentrated in that solution, in all parts of the solution, to exactly the same extent. Wherever there is a surface, the concentration of the substance is always greater near that surface, and it may come out of solution at that surface, and when I say "adsorption" in this connection, I mean the actual coming out of solution onto the surface to change the surface to a minute extent.

Q. 25. Did you make any quantitative examination of the amount of X-cake which thus was adsorbed upon the surfaces of the mineral particles?

A. We tried to. We got some figures. I do not know how accurate those figures are, because you will understand that in any of this work, where you are trying to measure the

amount of adsorption on surfaces, you are dealing with extremely minute quantities of substances, and the methods for measuring such extremely minute quantities of substances have not been developed to the extent that we would like. But I have actually made measurements, and the measurements seem to show that on a mineral surface as compared to a quartz surface—I should say, to be a little more precise, on a sulphide of copper surface, chalcocite, as compared to a quartz surface—there was about ten times as much that came out on the sulphide surface as there did on the quartz surface.

Q. 26. To go back a little, did you now wholly satisfy yourself that that was——

A. I beg your pardon. We did not use quartz. We used granite instead. It does not affect the answer that I made at all.

Q. 27. You satisfied yourself in the first place that that was where the missing X-cake was going to, that is, upon the particles of solid matter in the pulp, is that right?

A. We thought that was the major loss.

Q. 28. Did you make any tests to identify the presence of the substance there on those particles as distinguished from the quantity of the substance on them?

A. Yes, we did that. These experiments that I have just told you about were only one series of experiments. You will understand that these experiments I am talking about were not made in connection with any litigation. They were made simply to satisfy ourselves, as we really wanted to know what was happening. We made experiments like this:—We took some of this material on which the X-cake had adsorbed and we washed it thoroughly with water, so it was not a question of simply adhering solution, and then we dissolved the X-cake off with alcohol, and then we made chemical test to determine that it was X-cake.

Q. 29. Did you satisfy yourself that X-cake was actually on those surfaces?

A. I feel satisfied that it is. I do not feel there is any question about it.

Q. 30. And on the quantitative relation test figures, all you could get was something like ten to one as between the sulphide particles and the granite, is that right?

A. Those are a set of figures. I would not go so far as to say those are the best figures we can get, but there was substantially more on the one than on the other. There were many experiments that we made of different characters, but I am satisfied there was substantially more on the sulphide particles than on the gangue.

Q. 31. These granite particles, I suppose, were taken because granite is an ordinary constituent in the gangue of the ores that you were working with; is that the idea?

A. Taken with the general idea that in porphyry ore the granite is somewhat close to the porphyry. That is a rough approximation and why we took them. We also made such experiments using quartz. We simply picked substances that we thought were gangue materials or the type of gangue materials.

Q. 32. Can you give me any idea of the extent to which phenol is soluble in water at ordinary temperatures?

A. Yes. I think I remember some of the figures. It is soluble to the extent of 6 parts in 100 at 20 degrees C., 8 parts in 100 at 25 degrees C., and the solubility increases very rapidly, until at 67 degrees centigrade water and phenol are miscible in all proportions.

Q. 33. What is a normal operating temperature of flotation pulp today?

A. Most flotation operations today are in the cold, as we say. That is, they are conducted at the prevailing temperature whatever that happens to be.

Q. 34. Has that always been so?

A. No, the operations in the early days were usually hot. I would not say usually—yes, I think I will say, usually hot.

Q. 35. To what temperatures did they raise the pulp, roughly?

A. They went all the way from boiling temperature down to ordinary temperature, but I think the temperatures of 40 degrees C. and even 50 degrees C. were quite common.

Q. 36. Would there be a substantial difference in the solubility of phenol between 40 degrees C. and 20 degrees C.?

A. Yes, indeed. I have not the actual figures here, but I would say offhand that at 40 degrees C. a very large amount would dissolve, certainly. I would just guess at the order of 20 per cent. or more. We can supply the exact figures if you would like to have them, Mr. Davis. I do not happen to have them in my head.

MR. DAVIS: That is all from this witness.

THE COURT: Perhaps, Mr. Williams, you can come prepared on your cross-examination, if I should suspend here.

MR. WILLIAMS: I prefer to.

THE COURT: We will adjourn until tomorrow morning at ten o'clock.

(Whereupon an adjournment was taken until tomorrow morning, Friday, June 29, 1923, at ten o'clock.)

FIFTH DAY

Trial Resumed. Bangor, Me., June 29, 1923.
Met pursuant to adjournment.
Parties present as before.

MR. DAVIS: I would like to put in evidence the sample of blast furnace oil furnished by Mr. Shipley. Note on the record that Mr. Shipley produces this sample of blast furnace oil, as he promised to do, and it is marked Defendant's Exhibit No. 113, sample of blast furnace oil, L. B. Shipley.

(Received in evidence and marked "Defendant's Exhibit No. 113, Sample of Blast Furnace Oil.")

MR. DAVIS: And it is agreed that Mr. Shipley says that this is a fair average sample of blast furnace oil.

MR. WILLIAMS: As at present on the market.

MR. SHIPLEY: As at present on the market.

RAYMOND F. BACON resumes the stand.

CROSS-EXAMINATION

By MR. WILLIAMS:

XQ. 37. Dr. Bacon, you said in answer to question 7 that "it was not possible to float the great body of ores in this country, that is, particularly the copper ores." What kind of ores are the great body of copper ores in this country?

A. The ores that are commonly called the porphyries.

XQ. 38. And they are characterized by about what proportion of copper?

A. Very low grade, less than 2 per cent, I should say, on the average.

XQ. 39. Now you say that at the time this Fellowship of the Mellon Institute was founded "we were informed by those who founded the Fellowship," etc. Who gave you that information?

A. That was given by the engineers, I think, particularly Mr. W. H. Aldridge, who was one of the engineers connected with some of the large copper properties.

XQ. 40. What copper properties?

A. I do not know what copper properties, because at that time Mr. Aldridge was an engineer for Mr. W. B. Thompson and some of his associates. Mr. W. B. Thompson and his associates were some big financial holders, I think, of many of the copper properties in this country, and Mr. Aldridge was his general engineer, and, of course, then there were other engineers who reported to Mr. Aldridge.

XQ. 41. That is Mr. William Boyce Thompson?

A. Yes, sir.

MR. WILLIAMS: Will you admit that he is the principal stockholder of the defendant corporation?

MR. DAVIS: I would if I knew anything about it, but I don't.

MR. WILLIAMS: Do you know?

MR. AYER: No, I do not know that he is.

XQ. 42. Did you meet and receive instructions from Mr. John M. Callow in connection with this work?

A. I do not know that I did just at that time. I have met Mr. Callow many times and have talked with Mr. Callow. I would not say that I received instructions, because Mr. Callow knew more about, I would say, the mechanical side of the thing, and he also knew about commercial flotation. I often talked with Mr. Callow about the thing, and I often asked him questions about how things worked in the mill, and things of that kind, yes.

XQ. 43. Mr. William Boyce Thompson was the president of the Inspiration Consolidated Copper Company at that time, was he not?

A. I do not know whether he was or not. I know only by hearsay any of these things, you understand. I do not absolutely know. I think he was interested in it.

XQ. 44. In July, 1914, as I understand it, this Fellowship was started?

A. Yes, sir.

XQ. 45. And I suppose the work of investigation and information came very promptly, did it?

A. The work of information was prior to that time, because there were undoubtedly negotiations that dated back a few weeks before the founding of this Fellowship. The actual work started on July 1st.

XQ. 46. Were you advised that the Inspiration Consolidated Copper Company was at that time engaged in concentrating porphyry copper ore by flotation?

A. I do not know exactly at what time I knew the work was being done in Inspiration. I undoubtedly knew some time very soon after that that tests were being run at Inspiration to determine what was the best flotation process and the best methods to use. I would not say as to exactly when that information came to us, but certainly very close to that time. I might say, Mr. Williams, to make myself perfectly clear on this whole subject—I do not mean to say for a minute that it was impossible to concentrate copper ores by flotation, but I do say that it was the feeling, and I think the correct feeling, of the engineers, that we did not know enough about it to obtain sufficiently efficient results to make it a very profitable

operation. That was the feeling of the engineers certainly, and I think it is my feeling. I think it is the fact. I do not mean to say that it was not possible at that time to make a flotation concentration, because it certainly was possible, but it was a question of degree. Take in this case the question of the Inspiration ore, they had an ore there that was extremely low in copper. The amount of margin that they had to operate on was extremely small. To make that a profitable operation they must have very high recoveries.

XQ. 47. Did you or your assistants investigate the work that was being done at Inspiration?

A. Yes, I can not tell you the exact date, but we had the reports available to us right along as to what was being done from day to day at Inspiration.

XQ. 48. Were you advised that there was litigation then going on?

A. I do not know as to that time. I certainly knew that there was litigation in the Hyde case, and I rather imagine it was going on at that time, but I can not recall just when I knew that, but I certainly knew about the Hyde litigation.

XQ. 49. Did you give it some study?

A. Why, very little at that stage; in fact, practically none at that stage.

XQ. 50. The decision of the Ninth Circuit Court of Appeals which held the patent that we refer to as the first patent to be void, was rendered on May 4, 1914, and I see that this Fellowship was started in July, 1914. You were certainly advised of that decision, were you not, and of the decision that preceded it by Judge Bourquin, wherein the patent was held to be valid?

A. You mean by your question was I advised by the people that founded the Fellowship?

XQ. 51. Well, were you informed of it?

A. You mean had I informed myself?

XQ. 52. Either.

A. I cannot say as to this time. I think that there is no question that in reading up all the literature that we could on flotation, which was, of course, one of the first things we

did, there was no question but that probably very early we must have read that decision.

XQ. 53. That is, as a part of your investigation of the literature you would have come across it?

A. Yes, absolutely.

XQ. 54. Did you know anything about flotation before the work commenced in connection with this Fellowship?

A. I knew only a little. As I told you, I was in charge of a small mine in Colorado, in late 1904 and 1905, and the ore was a refractory sort of ore, that is, refractory to the processes that were in general use, and I remember at that time that I was in Denver, and there was some talk among some of the mining engineers as to the possibility of using flotation at that mine. Furthermore, I saw the flotation operation at the Butte and Superior mill, some time prior to 1914. So that I would say this—I had never made any intensive study of flotation prior to 1914, but I knew about it, as a man who was interested in new things would know about such things.

XQ. 55. Now you say at this time the processes in general use were being employed?

A. No, I did not say that, Mr. Williams; I said that the ore—you are speaking about this little mine in Colorado, are you not?

XQ. 56. Yes.

A. I said the ore was not adapted to the processes in general use at that time.

XQ. 57. And what were those processes generally?

A. The processes I refer to were processes other than flotation processes of any character.

XQ. 58. Well, generally, is not the name "water-concentration" or "gravity-concentration" a fairly good description?

A. It would not apply in this particular case, because in this particular case they not only tried gravity-concentration methods, but also tried solution methods. The ore was high in silver, and they had tried some of the thiosulphate solution methods.

XQ. 59. That is, dissolving the ore in a strong substance and trying to get the metal out that way?

A. Yes. They had also tried treating it in the blast furnace directly.

XQ. 60. And I suppose you may say that they were chemical processes, while gravity-concentration was a physical process, very generally?

A. Oh, very generally, yes.

XQ. 61. Did you give the name of that mine in Colorado that you referred to?

A. No, I did not say anything about it. The name of the mine was—I think at that time it was called—the Lasal Consolidated Copper Corporation—only a small mine.

XQ. 62. You made the statement, Doctor, in answer to Q12, that "all flotation agents which were successful agents were partly or wholly soluble in water, in the proportions used." What was the basis of that statement?

A. The basis of that statement was—I will say there were several bases. One basis, and I think the most stable one, was the large number of experiments which we had made which demonstrated that fact.

XQ. 63. Did you demonstrate that fact in relation to oleic acid?

A. Yes, sir.

XQ. 64. How?

A. I can give you a great many of the experiments. I will outline them first and then if you want the exact experiments, I will be glad to give them to you. We did it principally in this way: We take some oleic acid and make a solution of it by floating it on water. That is, you take oleic acid, and you float a small amount of oleic acid on a large amount of water, and then you give sufficient time for that oleic acid to dissolve. You see, in dissolving any substance in water, we may do it in two ways. That is, if I dissolve some sugar in water—a lump of sugar in coffee, we will say, for instance—if I want it to dissolve real quickly, I put it in and take my spoon and I stir it around, and it dissolves very rapidly. If I don't do it that way, it takes it a long

time to dissolve. There would be two ways in the case of oleic acid. You may add some oleic acid to water and you may agitate it, stir it thoroughly, and then if the oleic acid goes into solution, or, in fact, any substance—I am speaking generally—that solution will take place rapidly. It is almost self-evident why that is. On the other hand, you may simply put oleic acid on the water and give it a sufficient time for the water to diffuse up against the oleic acid, and the solution gradually diffuses down, and so on, and in either case you get the solution. Now, the reason for virtually all of our work, although we have worked where we used the stirrer, but virtually all of our work was done on the basis where we simply put the oleic acid on the water, and the reason that we did that was that we did not want to fool ourselves in any way or have any possible criticism as to the results, on the basis that what we were getting in solution was not a true solution of the substance, but was merely tiny globules that were suspended throughout the solution. If you take an oil and stir it with water, it is, of course, suspended through the water beyond the point that will represent a true solution in the water. It is possible, of course, to separate out those oil globules, and have the true solution remaining. We thought in our work—we simply happened to choose, we will say—the best way to do it was never to make those tiny oil globules at all, and, consequently, simply put the layer of oleic acid on top of the water and give it a sufficient length of time to dissolve in the water.

XQ. 65. And a sufficient length of time would be generally how much?

A. With oleic acid it generally takes about two days, and, in fact, we have experiments where we have used even longer times than that, but in two days you can get an amount in solution so that it is possible to prove that there is material gone into solution from the oleic acid.

XQ. 66. With those 48 hours' contact of the oleic acid and the water, and what you would call solution by diffusion—is that right?

A. You might call it that, if you want to. Any solution where you do not stir it around is solution by diffusion. If I put a lump of sugar in coffee and do not stir it in any way at all, and let it stand long enough, that lump of sugar will completely dissolve and will have diffused all through the coffee; but it takes a long time to do it. There is no difference in the actual solution whether you stir it or do not stir it. It is simply a difference in the time, because it is a question of the contact of the solvent water with the material that you are going to dissolve.

XQ. 67. What quantitative determinations did you make in regard to oleic acid?

A. We made determinations of this kind: After we had made the solutions in the way that I have spoken about, we then took that water and determined whether or not it would froth, and if it would froth, we said that something had gone into solution from the oleic acid. Then we went further than that. We took that solution and tried it on ore, to see whether it would float ore, and we found that it would float ore in a fairly satisfactory manner. I would say not as good as the oleic acid alone, but nearly as good. I would say also we tested the water in several different ways, two ways that I remember right now were, first, by tasting the water, this clear water solution alone; and if you taste such a water solution you get a very distinct taste of oleic acid, at least a taste that is exactly the same as if you taste oleic acid itself. Second, we tested the electrical conductivity of that water, because in the determination of extremely small amounts of substances in solution, you have to select very delicate means. All this time we are dealing with extremely small amounts, and the ordinary methods of testing for things of that kind hardly apply. You must get into the region of delicate methods, and one of the delicate methods of testing is the electrical conductivity of solutions. That is, those are standard methods, and we determined the electrical conductivity of this solution, and we found that the electrical conductivity of the water that had dissolved something from the oleic acid was greater than the electric conductivity of

the water before dissolving anything from the oleic acid.

XQ. 68. That is, pure water?

A. We took pure water to start with. All these experiments were made with distilled water. Then we also determined that there was a relation between the electrical conductivity and the frothing power of this solution. That is, if you let it stand for a short time against the oleic acid, it does not froth very much because there has not been very much gone into solution probably, and such a solution does not show as high an electrical conductivity as one that has been in contact for a longer length of time. Now, all of those things made us think that there was some reliability in electrical conductivity methods. Then the question came up as to whether or not the substance which was being dissolved from oleic acid was oleic acid itself. That is, it is conceivable that the substance that you are dissolving from the oleic acid might not be oleic acid itself, but might be an impurity that was in the oleic acid, we will say. To test that point we did two kinds of experiments. One kind of experiment was to get all the samples of oleic acid that we could and as pure as were on the market, and also to take some of those samples and purify them further by distillation or means of that kind, and then test each one of these samples separately. Now, if each sample, no matter what its source is, does put something into solution, that in each particular case tastes like oleic acid, then there begins to be a probability that that substance which goes into solution is oleic acid itself. And that was the fact. The second line of experiments which we made was like this: We took oleic acid and we dissolved out all that we could by agitation methods for a long time. That is, we took a sample and we dissolved it with water, and then we took that same oleic acid that had not dissolved yet in the water, and we treated it with more water, and so on, the idea being that if this was an impurity, then the impurity ought to be all dissolved out pretty soon, and what would dissolve afterwards would be the substance itself; and we found that in that case the final

solutions that we got after dissolving out many times with water still had these same properties.

By The Court:

XQ. 69. Is that what you call a quantitative analysis? The question he asked you was whether you made a quantitative analysis.

A. In this particular case I would say, strictly speaking, no, because these experiments did not say that it was soluble to the extent of 6 per cent or something of that kind.

The Court: It would be better, I think, to confine the answers to the scope of the question so far as you can. It makes the record very much easier to interpret.

By Mr. Williams:

XQ. 70. I thought you were giving me quantitative analyses, that is what I asked for.

A. I think that there is some quantitative relation, in the sense, certainly, where we made the measurements with the conductivity cell; I do not know, though, that it is quantitative in the sense that I know how to calculate those measurements to actual percentage, because I do not think there is any data on which you could do that. That is, I cannot say, from these experiments, that oleic acid is soluble to such and such a percentage, whatever it is. That is, I cannot give you any percentage. All I can say from these experiments is that I think that these experiments proved that oleic acid does dissolve to some extent.

XQ. 71. Now, glass dissolves to some extent, does it not?

A. Yes, sir.

By The Court:

XQ. 72. You would not call glass soluble in water?

A. I think you would in the sense that we are talking of here, for the reason that the quantities of substances that we are talking about that are used in flotation are so extremely small. That is, I have made an experiment, for instance, in which I have successfully floated ore with one-thirtieth of a pound of a flotation agent. Now, if you calculate that out, that means 1 part in 240,000. Even glass is soluble to that extent.

XQ. 73. Well, then, under your interpretation of the word "soluble," glass is soluble?

A. Yes, sir.

XQ. 74. Would anything be not soluble?

A. The trouble is that measurements have not been made. Now, I really think that if you go far enough, everything does have a slight solubility in water. For instance, we will take even the question of a metallic copper. Right down through the ages they say to put water in copper vessels if you want to keep it pure, and the scientist interprets that as an extremely minute amount of copper that goes in solution to help purify the water. Of course, the only reason, I think, that we have chosen this method is because in the actual flotation practice the force that we are dealing with and the quantities that we are dealing with are of this extremely small order of magnitude.

By Mr. Williams:

XQ. 75. Now, in testifying in regard to alpha-naphthylamin, I believe is your pronunciation.

A. Yes.

By The Court:

XQ. 76. Is that the X-cake?

A. Yes.

XQ. 77. You call it alpha?

A. There are two kinds of naphthylamin, one called alpha and one called beta.

By Mr. Williams:

XQ. 78. You said at the beginning of your answer to Q. 16 that alpha-naphthylamin was discovered, and, of course, it is quite clear from the rest of your answer that you meant that what you found was that alpha-naphthylamin was a good mineral-frothing agent. That is what you meant—that was the discovery, was it not?

A. Yes, sir. That is, you mean that alpha-naphthylamin existed before that time?

XQ. 79. It is a very old substance?

A. Yes, sir, very old substance.

XQ. 80. Now, you say that in the experiments wherein

the beneficial effect of alpha-naphthylamin was developed, you were using a standard mixture of oils? What was that standard mixture?

A. What I meant was that we had picked on a mixture for a series of experiments, which we called our standard mixture, and then we added to the standard mixture various substances which we were investigating.

XQ. 81. Well, do you know what the standard mixture was?

A. That we were using at that time?

XQ. 82. Yes.

A. I don't know whether I do or not. I could undoubtedly find it if I went through all of the records. I do not think that the records I have here have that in.

XQ. 83. Could you say generally?

A. Yes, generally it was a mixture—I think at that time a mixture of pine-oil with coal-tar.

XQ. 84. And this coal-tar, was it a thick, tarry substance?

A. No, it was not as thick as some tars. It was fairly thick, yes.

XQ. 85. And the pine-oil thinned it down to fluidity?

A. No, it was not as bad as that. The pine-oil made it more fluid.

XQ. 86. You defined adsorption as "the coming out of solution on to a solid surface or even on to a gas surface." Is adsorption the concentration that occurs in the fluid in proximity to some other surface, say the wall of the vessel, or is adsorption the coming out of that concentrated material on to the surface?

A. I think the word "adsorption" includes both of those things, because there is no question that in adsorption the first thing which happens in every case is the concentration of the substance against the surface, whether it is a solid surface, or a surface between a liquid or a gas, or any kind of a surface.

XQ. 87. But a concentration within the liquid?

A. Within the liquid. That is the first thing which hap-

pens. Then the word is also used to include the actual adsorption of the substance against the solid, that is, actually coming out, because, for example, an adsorption process is—that is, one which is actually used—like this: They take the extract of the bark that is used for making quinine, cinchona bark. Cinchona bark is dissolved in water, and then in order to get out the quinine—quinine is an alkaloid—from the cinchona bark solution, they add charcoal to that. Now, the charcoal actually absorbs quinine out of the cinchona bark solution and takes it away from all of these impurities, and then the solution is filtered off, and the quinine is with the charcoal and may be recovered from the charcoal by appropriate methods.

XQ. 88. Did not you say that the charcoal absorbed?

A. Yes, sir.

XQ. 89. So that here you have adsorption in the liquid and absorption by the charcoal, is that right?

A. There has been a difference, Mr. Williams, in the use of the two words, adsorption and absorption, and I think that you will find unquestionably that there are scientists who use the word adsorption in a very narrow sense, of being this layer against the surface, this concentrated layer. Now, the actual fact is this: That not so many years ago they only used the word absorption for all these processes, and then as scientists went on, certain schools said:—We will limit, we will talk about two kinds of things, absorption and adsorption, and we will limit the word "adsorption" to the particular things that you are mentioning; that is the concentration in the layer; and where it comes out, we will call that "absorption," or we will even call it some other things. I think some of them perhaps use other words; but there is no question that the forces which are brought into play there are probably of the same character, and I think you will find that there is a difference of opinion, or at least a progression in the use of the words. I am willing to agree that there are a number of scientists who use the word "adsorption" referring only to the concentration in the surface layer.

XQ. 90. In the liquid?

A. In the liquid, yes.

XQ. 91. And in the dye industry, is not the thing that happens there something like what you have described for charcoal; that is, you say you have a fabric in the liquid and you have dissolved in the liquid the dye material, and there is adsorption at the surface where they meet, and then the particles go into the material and dye it. Is not that a fair description of what occurs in the dye industry?

A. I think that is all right.

XQ. 92. Whether we call the first adsorption and the taking of the material into the dye absorption or not?

A. I do not think it makes very much difference what we call it. The processes are essentially the same. That is, my conception of what happens in the case of alpha-naphthylamin, is very similar to my conception of what happens in the dyeing of a fabric.

XQ. 93. Does alpha-naphthylamin go into the copper?

A. No, but it goes on the surface. Of course you say that the dye goes into the fabric. The fabric is more or less porous. You must remember that the fabric is made up of a lot of little tiny threads, and as to whether it goes into the inside of every one of these microscopic threads, I am not sure. But in the case of a copper ore, it certainly does not go into the copper ore.

XQ. 94. If it is a good job of dyeing, it ought to go pretty well through, should it not?

A. It is a question of whether it goes into the microscopic threads. It certainly ought to go on to every thread, but you must remember you have microscopical pieces there.

XQ. 95. This adsorption is a phenomenon in the range of molecular attraction, is it not?

A. Yes, sir.

XQ. 96. Suppose you have salt, common salt, sodium chloride dissolved in pure water, say about three per cent salt, and that solution comes up against a surface, is there adsorption in the liquid in proximity to the surface, or at the surface of the layer?

A. Yes.

XQ. 97. What kind of adsorption then occurs?

A. I do not know about the particular surfaces, but I know that in every case there is adsorption in the solution against the surface; that is, in a sense that we will say if the solution was three per cent in the body of the liquid, right against the surface is slightly more than three per cent, that is slightly more than three per cent in solution against the surface.

XQ. 98. I have been informed that negative adsorption is the thing that takes place there.

A. In the case of the sodium chloride?

XQ. 99. In the case of sodium chloride?

A. I do not happen to know about the particular case of sodium chloride. But I know that as a general rule, there is adsorption in the case of liquids, and I think that there are cases where there is negative adsorption.

XQ. 100. And will you just give us a picture of negative adsorption?

A. In negative adsorption you would have the opposite situation, that instead of there being a concentration, there would be a lesser amount.

XQ. 101. A dilution?

A. A dilution, yes.

XQ. 102. That is to say, at the surface, there would be less of the thing in solution than elsewhere?

A. I am assuming that is the fact, and, as I said, I do not know in that particular case.

XQ. 103. I am only asking for a definition of negative adsorption. That would be negative adsorption?

A. Yes, sir, if that happens. As I say, I do not know about it.

XQ. 104. Now you testified in answer to Q. 25 that you made quantitative examination of the amount of X-cake, or that you tried to make quantitative examination of the amount of X-cake, which was adsorbed upon the surfaces of the mineral particles, and you only gave us the results, and I take it that you did not express any very strong conviction as to the accuracy of the quantitative results; but could you give a gen-

eral idea of the experiments that you carried on for the purpose of determining, or attempting to determine that?

A. Yes, I made experiments like this: We took chalcopyrite as a mineral and granite as a gangue, and they were first ground up, each one of them separately, and were sized so that all which remained on 40-mesh was rejected and all the portion between 40-mesh and 200-mesh was used.

XQ. 105. Less than 40 and greater than 200; is that right? Minus 40 and plus 200?

A. Yes. Then exactly equal volumes of the two were taken and they were then soaked for exactly the same length of time and under the same conditions in an X-cake solution.

XQ. 106. And about what length of time, very generally?

A. About one hour, and with a solution containing, I think, one part in 1,000, perhaps less than that. I will look it up and tell you. One part in 10,000. They were treated in exactly the same manner all the way through. Then the X-cake solution was filtered off from each one in exactly the same manner and the same time, and then they were washed—

XQ. 107. How were they filtered off?

A. On a suction filter.

XQ. 108. With filter paper?

A. Yes. Those were washed, each one of them, ten times, I think, with hot water.

XQ. 109. On filter paper?

A. Yes. I will make sure. Anyway, they were washed a number of times. I will go ahead with it, and if you want to ask me about any of the details I can give it to you. They were washed a number of times with water, with the idea of washing off first the solution that was naturally adherent. After they had been washed a certain number of times, we began to make tests of filtrate. That is, a definite amount of water was poured into one and the same amount into the other, and we began to make tests of that water that came through, to see whether or not it was taking off X-cake from the two substances. Now, we found that after the adherent water, that is, the water that had just been thoroughly washed off by these preliminary washings, then you begin to find

this: That on passing successive portions of water through, the X-cake comes off very much faster from the gangue material—the granite—than it does off the chalcopyrite. That is, you find in the early stages of the testing that the filtrate, that is, the water which has passed through the gangue material, contains more of the X-cake than the one which has passed through the chalcopyrite. We continued that washing until there was no more came off of either one, that is, until the test, which was an extremely delicate one, was virtually negative. We then washed each one of them with alcohol, that is, with a solvent that would more easily dissolve X-cake in case any X-cake were still remaining on the two comparative samples. Then this alcohol solution was tested with the color reagent to determine how much had been washed off by the alcohol and the results obtained showed that there was approximately ten times as much washed off of the chalcopyrite as off of the granite.

XQ. 110. Washed off by the alcohol?

A. Washed off by the alcohol; yes, sir; after you washed as thoroughly as you could with water, to get it all off with water.

XQ. 111. Was the material that you used the commercial X-cake or pure alpha-naphthylamin?

A. This material that was used in this case was Kohlbaum's chemically pure alpha-naphthylamin.

XQ. 112. So that really that material should not be called X-cake, because X-cake is the commercial name of the rather impure material which is used in practice; is that right?

A. I would not say that at all, because it is a question of just the same substance. I do not see that, because on the same basis I would not call sugar sugar unless I got refined sugar; there is nothing to that.

XQ. 113. I thought that you had used the two terms differently, and I wanted to make sure it had no special significance.

A. No, in any case, unless I have specifically spoken, when I said X-cake or alpha-naphthylamin, I was using the terms synonymously unless I made a special statement.

XQ. 114. What specifically were these chemical tests to determine the presence of alpha-naphthylamin in the alcohol with which you finally washed these materials?

A. They were tests with sulphanilic acid. The directions for testing were:— "Add to the solution to be tested for X-cake 1 cc. of a water solution containing 8 grams of sulphanilic acid and 50 cc. of hydrochloric acid in 1000 cc. of solution, followed by 1/10 cc. of a solution containing 1 gram of sodium nitrite in 100 cc. of water."

XQ. 115. Now, when you found ten times as much alpha-naphthylamin obtained by the last operation from one material than from the other—of course you give its relativity. How about quantities? Take the larger quantity, did you determine that?

A. Yes, they are very small. I will give you the exact figures if you would like to have them. On chalcopyrite in this particular experiment we found .00025 grams and on the granite 0.000025.

By The Court:

XQ. 116. Which one has the most zeros there?

A. The last one.

XQ. 117. The more zeros the smaller apparently?

A. That is of the two numbers, one happens to be just ten times the other. I do not think the relation of ten to one is the exact relation by any means.

By Mr. Williams:

XQ. 118. Can you, just to help the Court in this picture of the amount, give the relation of a gram to a pound?

A. A gram is approximately 1/450 of a pound.

XQ. 119. What was the weight of the chalcopyrite from which you extracted this rather small quantity of alpha-naphthylamin?

A. 108 grams.

XQ. 120. And what was the weight of the granite?

A. 68 grams. Both had a volume of 50 cc. when closely packed.

XQ. 121. So that the surfaces were very nearly the same, is that the idea?

A. As nearly as we could make them, they were the same. We tried to make them the same.

XQ. 122. In these tests to determine the presence of alpha-naphthylamin in alcohol, what colors did you get? Is that noted?

A. We got a red color, sort of a red color.

XQ. 123. Suppose there were oxidation or decomposition of products present, would the tests have indicated that or would the results have been the same?

A. We have considered those things rather carefully and have tried to exclude those things. In much of our early work we had some trouble with such things, and we thought that by the way we had worked the test out that we had excluded those possibilities. I want you to understand that I don't think this represents the actual quantities that may be present at first, but it is only a measure of relativity. That is, I do not lay any too much stress on this being the actual quantity that is present, or I do not lay too much stress even on the question of a ten to one ratio. I think I have tried to make that clear all through the testimony.

XQ. 124. I take it that this phenomenon of adsorption takes place in practically all liquids, does it not?

A. It is a general phenomenon, yes.

XQ. 125. And it would take place in alcohol, would it not?

A. Oh, yes.

XQ. 126. In regard to what you did to investigate the solubility of oleic acid, did you make any chemical tests to determine the presence of oleic acid in that clear material that you had?

A. Only in this way. I think I will answer the question one way, and then another, to make it perfectly clear. We made no chemical tests, if I understand by that that you suppose that there are some chemical tests that can be made for oleic acid. So far as I know there is no chemical test that can be made for oleic acid—that is a delicate test that would be capable of detecting quantities of this kind. But outside of the two tests that I have mentioned, we also evaporated some of the solution and determined that the oleic acid began to come out of solution in the way that it should, if we would

assume that it was oleic acid. But I do not consider that is a definite chemical test. I will say that so far as any definite chemical test that would enable you to say beyond any question whatsoever that this stuff that went into solution was oleic acid, that we did not determine so; but that we considered, for the reasons I have already outlined, that there was a very great probability that it was.

XQ. 127. Did the Mellon Institute, when you were its director, circulate the pamphlet which I now hand you?

A. Yes, sir; if you mean by circulating it, it sent out quite a number of these pamphlets to mining engineers and people of that kind.

XQ. 128. Throughout the country?

A. Yes, sir.

XQ. 129. The date appearing below your name on the document is July 27th, 1917. Is that about the time that it was sent out?

A. Yes, sir; I suppose shortly after that, actually. It is probably the time that I wrote that particular thing.

XQ. 130. The date of the decision of the Third Circuit Court of Appeals, in the Miami case, is May 24, 1917. I presume you received a copy of that decision shortly after it was rendered, did you not?

A. Yes, sir, I think I undoubtedly did.

XQ. 131. You were watching the litigation, of course?

A. At that time, yes, sir.

XQ. 132. Now, this document is entitled as follows:

"ORE FLOTATION.

OPINION RENDERED BY UNITED STATES CIRCUIT COURT OF APPEALS AND DISSENTING OPINION

Third Circuit.

Cases 2180 and 2181.

Minerals Separation, Limited

vs.

Miami Copper Company."

Now, the introduction which contains your name at the end of it, was written by you, was it not?

A. Yes, sir.

XQ. 133. And then follow the decisions written by Judge Woolley, the dissenting opinion by Judge Buffington, and the decision of the Supreme Court of the United States in the Hyde case; is that right?

A. I think that is correct.

XQ. 133-a. The introduction is:

"The mining world has been for several years in a state of uncertainty as to the legal status of the several ore flotation processes. Such uncertainty does not make for progress in the development of the industry. Anything which mining engineers can do by discussion in the technical press toward making perfectly clear all the facts of the various processes of flotation will be of great value to those who may have to do with the legal aspects of the question. Operating men are now rather familiar with just what steps must be taken to obtain a satisfactory recovery of values from the ore by flotation methods. The Mellon Institute is sending you this pamphlet containing the full opinions rendered in the U. S. Circuit Court of Appeals for the Third Circuit in Cases No. 2180 and 2181, Minerals Separation Ltd. vs. Miami Copper Company. It is believed that the full opinions will be of interest to you and it is hoped that they will stimulate intelligent discussion.

"The majority opinion of the Court rendered by Judge Woolley sustain the validity of the patents in suit owned by Minerals Separation, Ltd., and holds they have been infringed by the Miami Copper Company. Judge Woolley's opinion also holds that the floating of ore in a cell of the Callow type, providing there is no preliminary agitation of the ore pulp beyond that provided in the prior art for mixing the oil with the ore pulp would not infringe the patents in suit. The minority opinion rendered by Judge Buffington finds that the process used by the Miami Copper Company is not the process of violent mechanical agitation forming a persistent froth, as provided for in the patents in suit and that there has been no infringements.

"Having spent some years in the study of ore flotation processes and the literature upon the subject, it is my

personal opinion that the minority opinion of the court is more closely in accord with the facts as mining engineers see them and it should be sustained. I am able to say that all of a large number of neutral mining engineers with whom I have talked have expressed the same view. Review of this case by the Supreme Court of the United States will be awaited with great interest. For the sake of completeness, I have added the decision of the U. S. Supreme Court in the case of Minerals Separation, Ltd., and Minerals Separation American Syndicate Ltd., vs. Jas. M. Hyde on the validity of U. S. Patent No. 835,120, issued to Sulman, Picard and Ballot.

RAYMOND F. BACON,
Director of the Mellon Institute of Industrial Research.
University of Pittsburgh, Pittsburgh, Pa.
July 27, 1917."

A. Yes.

XQ. 134. It is suggested to me that you may have determined the surface area of those sorted particles of granite and sulphide of copper which were used in that determination?

A. No, I did not, in that determination.

MR. WILLIAMS: That is all.

RE-DIRECT EXAMINATION.

By MR. DAVIS:

RDQ. 135. Dr. Bacon, in this quantitative test that you describe, for the presence of X-cake, you said that you first washed the mineral particles and the granite particles a number of times with water. The purpose of that was to wash off as much of the X-cake as you could wash off with water?

A. Yes, sir.

RDQ. 136. Am I correct—these questions are leading, if there is no objection, because I think we can get along faster that way—am I correct in understanding that you continued to wash with water until you could no longer get any appreciable X-cake off with the water washing; did you continue the water washing until you could not get any more X-cake off with water?

A. Yes. We washed in this particular experiment 37 times.

RDQ. 137. And the very minute quantities of X-cake that were finally dissolved by alcohol was X-cake, of course, that could not be washed off by water?

A. Could not be washed off within any reasonable length of time.

RDQ. 138. You spoke of one case in which you prepared an extract or solution of oleic acid, and used that as a frothing agent to determine whether it would form a froth or not, and found it did form a froth. Do you remember in what proportion of water that solution was made?

A. I do not think I understand that question.

RDQ. 139. Can you give us any—I do not mean the proportion of water to the amount of oleic acid dissolved in it, but I mean the proportion of water that you used in making that solution to the total amount of oleic acid that was put in it?

A. Well, it was very large. If I understand your question correctly, we probably had 2000 or more cc. of water to less than 1 cc. of oleic acid. Is that it?

RDQ. 140. Yes, that is the question. The proportion was generally in that relation, 2000 parts to 1?

A. Yes, it was probably more than that as a matter of fact. It was of an order of magnitude of that character.

RDQ. 141. What I am trying to get at, Dr. Bacon, is whether the oleic acid added to the water there was in the proportions of flotation as they have been discussed here?

A. You mean the oleic acid added originally to the water?

RDQ. 142. Yes.

A. Yes.

RDQ. 143. Do you know whether glass, if added to water in that proportion, would show any discoverable solution of glass in the water?

A. Absolutely. When I say "glass," you will understand there is a great difference in the solubility of different glasses. There are some glasses which are quite soluble. In fact, the ordinary glass that is used for window panes is fairly soluble. Then, they make other types of glass, like the glass that is used for chemical glassware, that is quite

insoluble, but the ordinary type of soda lime glass that is used for some purposes is fairly soluble in water and is of the same order of magnitude as the oleic acid that we are talking about.

Mr. Davis: That is all.

Re-Cross-Examination.

By Mr. Williams:

RXQ. 144. I do not know whether I quite understood you, doctor. Did you express any opinion as to the quantity of oleic acid that was dissolved in that filtrate?

A. No, I expressed no opinion as to the quantity. I simply understood Mr. Davis to mean that when I had made these experiments, did I take a quantity of oleic acid in relation to water that was within the limits of what has been given in this patent 835,120. That is calculated as less than one per cent on the ore, and my answer was yes, that I did, but I expressed no opinion at all as to the quantity of oleic acid which was actually in the water in solution.

RXQ. 145. Now, of course, you know that in practice the amount of oleic acid, although a fraction of one per cent, is more nearly one-tenth of one per cent.

A. I know it.

RXQ. 146. Was that the proportion that you started with, about two pounds to the ton of ore?

A. It will take me a long time to find this. I think I can answer your question in another way, which is perfectly accurate with the facts, that when you dissolve a substance in water, and assuming that it has a limited solubility—a small solubility—it does not make any difference at all whether you had on top of the solution—whether you had 1 gram or a hundred grams, the amount which goes into the solution is only so much, and if I had added even the minimum amount that is given in your patent, all of it would not have gone in the solution in that much water. So that it does not make any difference whether I add the minimum amount or the maximum amount expressed in your patent, only so much would have gone into solution, which amount

which could have gone into solution would have been less than the minimum amount expressed in your patent.

RXQ. 147. Now, when with this clear filtrate you agitated with an ore, you said you got a recovery. Have you got the figures of that operation?

A. I don't think I have them here, Mr. Williams; possibly I can dig them up.

RXQ. 148. Did you get a mineral-bearing froth?

A. Oh, yes. I remember, as I told you, that it was not as good. It was something of this order. I can tell you what it was. Now, these figures might not have been accurate, but we will say it was on an ore that with a good flotation agent you could get 95 per cent recovery. Now, what we got was something like 65 per cent recovery.

MR. WILLIAMS: That is all, doctor.

MR. DAVIS: That is all, doctor.

(Witness excused.)

HENRY W. NICHOLS, called as a witness on behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION

By MR. DAVIS:

Q. 1. What is your full name?

A. Henry W. Nichols.

Q. 2. By whom are you employed, Mr. Nichols?

A. By the Magma Copper Company.

Q. 3. Were you employed by the Magma Copper Company in the last three months of the year 1919?

A. Yes, sir.

Q. 4. What was your position then?

A. I had charge of the metallurgical work in the whole mill, and flotation department particularly.

Q. 5. As a metallurgist, did you keep yourself informed as to whether or not the pulp in the flotation plant of the mill was acid or alkaline?

A. Yes, sir.

Q. 6. Was it acid or alkaline during this period?

A. It was alkaline.

Q. 7. Throughout that period?

A. Yes, sir.

THE COURT: That is the critical period?

MR. DAVIS: Yes, sir. I am confining myself as to that, although I would like to say, for your Honor's information, only for the reason that the plaintiffs have. The pulp has always been alkaline at all times.

Q. 8. What, if anything, was added to the ore to make the pulp alkaline?

A. We added lime.

Q. 9. How did you determine whether the pulp was alkaline or not?

A. At frequent intervals I would take samples of the pulp, and after it had settled enough to get clear water off the top of the samples, I tested with phenolphthalein.

MR. DAVIS: Will you agree that that is the recognized test for alkalinity?

MR. WILLIAMS: It is a very delicate test, not the ordinary test at all.

Q. 10. Is it the test, the usual mill test for alkalinity of the pulp?

A. Yes, sir; I think it is.

Q. 11. If the indication of alkalinity was low on these tests, what did it indicate to you with respect to the lime?

A. It indicated that we were not adding enough lime.

Q. 12. Did the fact that there was not enough lime added have any apparent effect on the operation of the flotation cells?

A. Yes, sir.

Q. 13. What effect?

A. We could not get over enough froth to obtain a suitable recovery.

Q. 14. Do you mean by the words "suitable recovery" a recovery that would satisfy Mr. Browning?

A. Yes, sir.

Q. 15. Who was Mr. Browning?

A. He was the general manager of the Magma Copper Company.

CROSS-EXAMINATION

By MR. WILLIAMS:

XQ. 16. Did you test the pulp with litmus paper?

A. Yes, sir, I have at different times.

XQ. 17. Did it show alkalinity with the litmus paper test?

A. I could not say. Litmus is not quite delicate enough to show up plain enough to see.

XQ. 18. Where did you test the pulp?

A. In the mill.

XQ. 19. Well, the mill is very large.

A. Oh, it would be in the sample room of the mill.

XQ. 20. But where did you take the specimens from with which you made the tests?

A. Well, at various points. Sometimes it would be from the pulp that was fed into the cell, sometimes the overflow of the drag classifier, sometimes pulp baled out of the cell, and sometimes the tails from the cell.

XQ. 21. So that you tested heads and tails?

A. Yes, sir.

XQ. 22. And sometimes at points between?

A. Yes, sir.

XQ. 23. No one special point where you made your tests?

A. No, sir.

XQ. 24. And how often did you make these tests?

A. Just intermittently, as I required the information.

XQ. 25. When you said that the test for alkalinity by phenolphthalein was the usual mill test, did you mean the usual test in your mill?

A. Yes, sir.

MR. WILLIAMS: Cross-examination closed.

MR. DAVIS: I think that perhaps it will help if I say to your Honor, at this point, that Mr. Nichols was not called for the purpose of proving that the pulp was alkaline, because there is no dispute about that, but for

the purpose of proving that the addition of lime was for an actual mill operation purpose, and gave better flotation results. That is all.

(Witness excused.)

WILLIAM SYDNEY STEVENS, called as a witness on behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION

By MR. DAVIS:

Q. 1. Mr. Stevens, you came here in response to a subpoena issued by the Court?

A. I did.

Q. 2. In what business were you engaged in the latter part of the year 1908 and the first part of the year 1909?

A. I was a metallurgist at that time, in London, England.

Q. 3. By whom were you employed?

A. Minerals Separation, Limited.

Q. 4. Who were your immediate superiors?

A. At that period I was reporting directly to Mr. H. L. Sulman, Mr. Greenway, Mr. Theodore J. Hoover. Mr. Hoover was the general manager of the Minerals Separation at that time.

Q. 5. As metallurgist there, did you conduct a series of experiments upon the effects of a large number of agents as frothing agents in the agitation-froth process?

A. I did.

Q. 6. Did you make written notes of those tests?

A. I did, in the form of reports.

Q. 7. Will you produce them and let me see them?

A. I will (producing papers).

Q. 8. These papers that you have handed me seem to be carbon copies of a series of letters and a series of results of experiments, is that right?

A. That is true.

Q. 9. Are these carbon copies of the original reports?

A. Yes, sir.

MR. DAVIS: I offer these reports in evidence as Defendant's Exhibit No. 115.

(Received in evidence and marked "Defendant's Exhibit No. 115, Stevens Reports.")

MR. DAVIS: That is all, Mr. Stevens.

MR. GARRISON: If there is no objection, we will recall Mr. Stevens, if we want to ask him anything about those. He will be available for a while yet?

MR. DAVIS: Yes. Mr. Williams, I have here a bottle containing some X-cake such as defendant uses, and a bottle containing a mixture of 50 cc. X-cake and 50 cc. water. I would like to put these in evidence, if we can agree.

MR. WILLIAMS: One is in water and the other is dry.

MR. GARRISON: Put them in.

MR. DAVIS: I offer in evidence Defendant's Exhibit No. 116, a bottle of the X-cake used at the defendant's mill. It is marked "X-cake Magma Copper Company," and it is agreed between counsel that this is a sample of the X-cake from defendant's mill.

(Received in evidence and marked "Defendant's Exhibit No. 116, X-cake Magma Copper Company.")

MR. DAVIS: And I also offer——

MR. GARRISON: Let me correct that for a minute. We say that counsel says so, and we do not dispute it. We do not know where it came from.

MR. NEARY: We will put the witness on, then.

MR. GARRISON: That is as much as the witness could say.

THE COURT: It is accepted as such.

MR. GARRISON: Yes.

MR. DAVIS: And I also offer a graduate containing 50 cc. of defendant's X-cake and 50 cc. of water, as Defendant's Exhibit No. 117.

MR. GARRISON: We accept that as the statement of counsel, which we do not contradict.

(Received in evidence and marked "Defendant's Exhibit No. 117, Mixture X-Cake and Water.")

MR. NEARY: We will call Mr. Chapman as on cross-examination. He is connected with the plaintiff company and one of the officers or agents of the plaintiff company.

MR. GARRISON: That is a most extraordinary idea.

THE COURT: That must be developed later. It is a matter of discretion.

MR. NEARY: We call him as on cross-examination.

THE COURT: I understand that is your attitude.

MR. NEARY: That is our attitude; that is all I can say about it.

GEORGE ALBERT CHAPMAN, called as a witness on behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. NEARY:

Q. 1. What is your position with the Minerals Separation North American Corporation?

A. I am assistant chief engineer.

Q. 2. With what company were you connected in 1903?

A. With Sulman & Picard.

Q. 3. Had Sulman & Picard any connection with Minerals Separation, Limited, at that time?

A. Minerals Separation, Limited, was not in existence at that date.

Q. 4. Well, its predecessor?

MR. GARRISON: I object to that, if your Honor please.

THE COURT: Name the company.

MR. NEARY: I will ask him to name it.

Q. 5. With what company was Sulman & Picard connected at that time?

A. Speaking from memory, I think they were acting as consulting engineers to the Australian Ore Concentration, Limited.

Q. 6. Was that the predecessor of the Minerals Separation, Limited, if you know?

MR. GARRISON: Now, if your Honor please, I do not know what that means.

THE COURT: Predecessor in what way?

MR. NEARY: I will ask him.

Q. 7. Do you know whether or not—well, I do not know that it makes much difference about that. Were Sulman & Picard connected with an ore concentration company known as the Australian Ore Concentration Syndicate, Limited?

A. That is my belief, yes.

Q. 8. Did you do some work for Sulman & Picard in connection with the concentration of ores at that time?

A. Yes.

Q. 9. Is this a note-book that you kept at that time of the work that you were doing for Sulman & Picard?

A. Yes, a portion of this note-book is in my own handwriting.

Q. 10. As I understand, the last part of this note-book which I show you contains notes of work on the Scammel Oil Process, commenced February 9, 1903, and done by you?

A. Yes, that is correct.

Q. 11. On the first page of the portion of the note-book last referred to, I find the legend "Oil Samples." Is that in your handwriting?

A. That apparently is.

Q. 12. And below it there is the legend "No. 1 Sample," is that in your handwriting?

A. That certainly is.

Q. 13. And following that are the words "Blast furnace oil," and in parenthesis "From Mr. Sulman;" is that in your handwriting?

A. Yes.

Q. 14. Now, immediately below that appears the statement: "Appearance showed it to be too light for oil work. Rough tipping test. Oil broke up badly sinking into tails."

MR. GARRISON: If your Honor please—have you finished that question, Mr. Neary?

MR. NEARY: No, not yet.

Q. 15. "Tried the addition of 1.0 per cent. SCl_2 to warm

oil—violent action—allowed to cool and stand for 24 hours. This did not improve oil. (N. B.: Sample to be kept for Chemical examination.)" Is that in your handwriting?

MR. GARRISON: Now, if your Honor please, I want to interpose an objection.

THE COURT: What substantive facts are you proposing to prove? Something, I think.

MR. NEARY: Yes, sir. That blast furnace oil referred to here was a substance known to Sulman & Picard in 1903.

MR. GARRISON: Well, in the first place, if your Honor please, they have not yet shown that Sulman & Picard ever saw that book, and in the next place, assuming that they are going to prove that, I do not just get its relevancy in a suit between this plaintiff and this defendant, but leaving the second thing aside, the fact that this gentleman in 1903 put certain notes in a book does not bind Sulman & Picard as yet.

THE COURT: Connect it in some way.

MR. NEARY: Will you stipulate, Mr. Williams, that this was a book which was offered in the testimony given in the Wolf case?

MR. WILLIAMS: Why, we will stipulate that this is a note-book of the Sulman & Picard laboratory, if that is what you want.

MR. NEARY: And that it represents work done under the direction of Messrs. Sulman & Picard in their laboratory.

MR. GARRISON: How can we admit that?

Q. 16. I will ask the witness that. Does this represent the reports of work done for Messrs. Sulman and Picard, and reports made to them on that work?

A. Yes, those are the notes I handed to Mr. Sulman.

MR. NEARY: That, I think, supplies the one link. Now, is there any further objection to it?

THE COURT: That seems to be a legitimate way of proving that certain statements there came to the attention of Mr. Sulman.

MR. GARRISON: Yes. I now no longer insist on that. I think that your Honor ought to rule whether or not the fact that he has shown that Mr. Sulman had reported to him on a certain date, whatever he wrote this witness, is irrelevant and immaterial in this case.

THE COURT: I will have to hear arguments on that. I do not know. It is shown that it did come to his attention, and whether that is important or not I do not know.

MR. NEARY: I will ask one more question before we discuss that question.

Q. 17. I note that this report states that the blast furnace oil was "From Mr. Sulman." Just what does that mean, Mr. Chapman?

A. It may mean one of two things. I may have received this sample of oil from Mr. H. L. Sulman, or from Mr. E. A. Sulman, his brother.

Q. 18. Was Mr. E. A. Sulman employed in the same laboratory?

A. Yes, at that time I believe he was.

Q. 19. And working for the firm of Sulman & Picard?

A. Yes, I believe he was.

THE COURT: Just give me your theory on the admissibility of that fact.

MR. NEARY: Blast furnace oil is a specific agent mentioned in a publication by Elmore, in 1907, showing the use of blast furnace oil in the Elmore vacuum process in 1907, which was before the supposed invention of the patent in suit.

THE COURT: Is that one of the agents used by him at that time for the purpose of getting this reaction, whatever it is?

MR. NEARY: This is to show that blast furnace oil was an oil used by Sulman & Picard in these ore-concentration processes.

MR. GARRISON: Not processes—experiments. You do not pretend those were processes?

MR. NEARY: I do not care about that. The meat

of it is that it brings to the knowledge of Sulman and Picard this blast furnace oil, which is a specific reference in the 1907 article, and carries the knowledge of the blast furnace oil to Sulman and Picard in 1903. Now, the question as to whether or not it is blast furnace oil, or what it is, is a matter probably for the Court's consideration; but this is evidence to the effect that this particular substance was known to Sulman in 1903. That is the purpose of it.

MR. GARRISON: To the extent that it proves that, I have no objection to it.

MR. NEARY: Will you answer the question? I will put it again.

Q. 20. I ask you whether or not this legend at page 1, under the title "No. 1 Sample Blast Furnace Oil," is in your handwriting?

THE COURT: You asked him that.

MR. GARRISON: I think I interrupted at that point and the argument took place.

A. Yes.

MR. NEARY: There is no necessity of putting this book in.

MR. GARRISON: I should not think so. You have read it on the record, and he said yes. Besides, that is a court record, is it not?

MR. NEARY: Mr. Williams presented it to me this morning.

MR. WILLIAMS: I would say that it is a record in evidence in the case of Wolf against Minerals Separation North American Corporation, now at issue in the United States District Court of Maryland, and by stipulation it was in my custody and I handed it to defendant's counsel this morning; so if anything is to be done in the way of using it in evidence, why, it must be simply copied—

THE COURT: You won't have to keep it any longer.

MR. GARRISON: It is not necessary.

MR. NEARY: I have read into the record the only

thing in the book that had any relation to this examination.

THE COURT: The book need not be offered.

MR. GARRISON: We agree.

THE COURT: Does that suit involve this same patent?

MR. NEARY: No, sir. It is a suit by another patent holder against the plaintiffs in this action.

MR. GARRISON: And in that case Mr. Neary happens to be with us.

THE COURT: Another patent?

MR. WILLIAMS: A patent known as the Wolf patent.

MR. GARRISON: He is attacking our patent number 835,120 and says it belongs to him.

MR. WILLIAMS: As a matter of fact, this suit in Baltimore is one of some 35 or more suits that have been brought under this Wolf patent, and they are suing the defendant here.

MR. NEARY: There is a suit in this court by the same plaintiff against this defendant.

THE COURT: One reason I asked is that I know Judge Rose very well, and he comes down here in the summer, and if it is the same patent, I am going to talk to him about it.

MR. GARRISON: We will be pleased to have your Honor do so.

By MR. NEARY:

Q. 21. Mr. Chapman, you actually handled during the work referred to in these notes a sample of blast furnace oil, did you not?

A. I must have done so, Mr. Neary.

Q. 22. Are you familiar with a substance known as M. S. F. O.?

A. Yes.

Q. 23. What does M. S. F. O. mean?

A. It was Minerals Separation fuel oil.

Q. 24. And what sort of a substance is that?

A. A dark liquid.

Q. 25. Do you know what its source is?

A. No.

Q. 26. Do you know whether it is a coal-tar product?

A. No.

By The Court:

Q. 27. You mean you do not know, or it is not?

A. No.

By Mr. Garrison:

Q. 28. You mean you don't know, or it is not?

A. I do not know.

By Mr. Neary:

Q. 29. Have you ever seen this M. S. F. O.?

A. Yes.

Q. 30. The substance known as M. S. F. O.?

A. Yes.

Q. 31. Does it look like the ordinary coal-tar product that is used in flotation?

A. Yes, it is similar.

Q. 32. Has it any odor?

A. Yes.

Q. 33. What is the odor?

The Court: It is pretty hard to describe an odor, I suppose. Is it good or bad?

Mr. Neary: I think Mr. Chapman might be able to describe it.

A. My difficulty is, of course, that I have not smelt or seen M. S. F. O. since 1913 or 1914.

Q. 34. I will hand you a sample of blast furnace oil, marked with the legend "L. B. Shipley," and which is Defendant's Exhibit No. 113, and ask you whether or not the substance which you knew as M. S. F. O. has the odor of that substance?

Mr. Garrison: I have no objection, probably, because I am not going to make it on the ground that it is immaterial. I think the two things are nearly alike, but chemically that will be of very little moment.

A. That smells very similar.

By THE COURT:

Q. 35. Do you remember an odor for ten years?

A. Yes, sir.

By MR. NEARY:

Q. 36. Does that smell like carbolic acid?

MR. GARRISON: The Court can tell that as well as the witness. Your Honor does not have to ask an expert witness whether a thing smells like carbolic acid. Your Honor can smell it.

THE COURT: He may answer.

MR. GARRISON: I have not smelt it, and I would not be deprived of that pleasure.

A. There is a suggestion of that smell.

Q. 37. Where have you known this substance M. S. F. O. to have been used in flotation purposes?

A. At the Braden Copper Mines, Chili, South America.

Q. 38. Any other place?

A. I do not recollect any others, Mr. Neary, now.

Q. 39. Do you know by whom this substance was supplied to the Braden Copper Company at the time you have reference to its use there?

A. No.

Q. 40. Do you know from what source it came?

A. Except that it was bought through Minerals Separation, I should think, on account of its title being "Minerals Separation Fuel Oil."

Q. 41. And you don't know where Minerals Separation bought it?

A. I have not got the slightest idea.

Q. 42. You say that the letters "M. S. F. O." mean Minerals Separation Fuel Oil. Did that substance, as you recall it, have an odor similar to petroleum oils?

A. I should say that it did not.

Q. 43. Mr. Chapman, in the portion of this article by H. L. Sulman, entitled "A Contribution to the Study of Flotation," which has already been read into the record, there is a statement to the effect that in connection with the work

on a patent that was filed in 1903. "It was also found that ore particles could be temporarily suspended in the froths yielded by aqueous solutions of amylic alcohol and other substances, not so readily in one of soap and not at all in those of saponin, ox-gall, or tannic acid; but for similar reasons these experiments were at that period unproductive of practical result." Do you, owing to your familiarity with the work of Sulman-Picard's laboratory at that time have any knowledge of the tests or experiments there referred to? Would you like to look at that?

A. I would like to look at it.

Q. 44. It begins right here (indicating).

MR. GARRISON: I suggest, before you answer, Mr. Chapman, that the question be read, so you know what to answer. (Q. 43 repeated.)

A. Yes, I have knowledge of some of the tests referred to there.

Q. 45. Have you knowledge of any tests with the froths formed by aqueous solutions of amylic alcohol and other substances?

MR. GARRISON: I want to enter an objection. I do not suppose your Honor is sufficiently advised as to that to rule upon it. Whatever this may disclose as to the knowledge of this gentleman, Mr. Neary might interrogate upon. But whatever appears to be the knowledge of Mr. Sulman does not affect us in any issue in this case.

MR. NEARY: This is the knowledge that Mr. Sulman has stated here, and I am merely trying to get more detailed information with regard to it.

MR. GARRISON: My objection stands. As I understood Mr. Neary, and I assume that is right, that is in evidence, so I am not quibbling about that. What I am saying, if Mr. Chapman is being interrogated, he certainly can not be interrogated about anything that Mr. Sulman knew. It must be some knowledge affecting the issues in the case. If it is something that has a bearing

on something that is attributed to Mr. Sulman, that can not affect these issues.

THE COURT: You may ask him that, at the moment, anyway.

MR. GARRISON: And your Honor will reserve to us the right to strike out?

THE COURT: Yes.

A. I have no knowledge of any froths during that period.

Q. 46. Well, laying aside the question of froths, have you any knowledge of the experiments that were conducted at that period with the substances named?

A. Not with amyl alcohol, certainly, I have no recollection.

Q. 47. Have you a recollection of experiments conducted with aqueous solutions of other substances?

A. No.

Q. 48. Have you any recollection of those conducted with soap?

MR. GARRISON: What date, now?

MR. NEARY: These same experiments I am talking about, whatever it means to the witness.

MR. GARRISON: That is not a fair thing to either the Court or me.

THE COURT: It is fair to identify the dates.

MR. NEARY: I thought I had done that in placing before the witness and speaking of these particular experiments referred to in this paper. The witness says he understands what that means. Whatever it means to him, I want to get the effect of it. He says he has no recollection of experiments producing froths at that period. I am asking him if he has any recollection of experiments which seem to be referred to here, in which soaps and other substances were used. I am referring, of course, to the period that I understand to be referred to here, namely, in 1903.

MR. GARRISON: That is all right.

A. The question, please.

THE COURT: Perhaps Mr. Neary can summarize it better in a question again.

Q. 49. Have you any recollection of experiments with soap?

MR. GARRISON: At that period.

THE COURT: At that time.

A. Yes, in this respect; we used oleic soaps in the operation of the Cattermole process, and this soap was added to an acidified solution and the oleic acid precipitated upon the mineral, for the purpose of granulating the mineral, and the tailings from the Cattermole process were placed into a small spiral machine and test conducted upon that material. To that extent I can remember the use of soap.

Q. 50. Did you use soap other than oleic soap in any such experiments?

A. I believe not.

Q. 51. Are you sure about that, Mr. Chapman?

A. The only other example of the use of soap in the same method of procedure, was the use of soft soap in the preparation of emulsions for use in the Cattermole process, and I think I can safely say they are the only two examples of the use of soap that I remember at that time.

Q. 52. Did you make any such experiments with substances such as alkaline cresylates or phenolates?

MR. GARRISON: I think he ought to fix the time.

THE COURT: The same period.

MR. NEARY: The same period.

A. No.

Q. 53. Did you at any subsequent period in that laboratory?

MR. GARRISON: Now, if your Honor please, I do not exactly see what the point of this is.

THE COURT: Do you want to show certain facts developed by him from experiment, or do you want to show knowledge received by others of certain facts that came to his attention?

MR. NEARY: The knowledge of these employers of

his. Of course if it was done wholly apart from the laboratory and without the knowledge of these other parties, it would have no bearing in this case, and have no weight or consideration on the part of the Court. In spite of the fact that Judge Garrison insists on interrupting me, I think it is perfectly clear that what I am referring to is this period during which the experiments referred to were conducted, and in the laboratory of Sulman & Picard. With that explanation, it seems to me that there is no necessity for any further interruption.

MR. GARRISON: I shall interrupt whenever I think it is proper.

THE COURT: It is not the interruption that is so important, because if the question is objectionable he has a right to interrupt. It is for the purpose of straightening out your interrogatories. If it is your purpose to show that one Sulman had knowledge of certain experiments carried on by this gentleman, so far as I can see, it is all right.

MR. NEARY: Yes, sir.

MR. GARRISON: I do not object to that.

A. Not to my knowledge.

Q. 54. Did you make any such experiments in Sulman & Picard's laboratory, or under their direction at or about that time with saponin, ox-gall, or tannic acid?

A. No.

Q. 55. You stated that in those experiments you treated the tailings (produced by the granulation process in the oleic acid soap solution work) in a coil pipe machine. Will you explain just what that machine was?

MR. GARRISON: I think the witness said spiral. Are coil and spiral the same thing?

MR. NEARY: Yes, we have talked about them that way.

MR. GARRISON: I do not know, you see. You know this art better than I do. I am trying to find out.

Q. 56. They are the same thing for the purposes of this discussion, are they not, Mr. Chapman?

A. Yes, Mr. Neary. This machine was a rectangular vessel, made of glass, so that we could observe the operations that took place. The bottom of this rectangular vessel was a circular trough, in which rotated a coil made of lead pipe, perforated, and this coil was connected through convenient stuffing boxes to an ordinary bellows blower, operated with the foot, so as to blow air through this coil, and when air was being pumped through the coil, the coil was being slowly turned or revolved. The vessel was usually filled with water and tailings from a previous Cattermole operation placed in the vessel.

Q. 57. Mr. Chapman, were all of the experiments to which you have referred in the last series of questions done in Messrs. Sulman & Picard's laboratory, and under their direction or with their knowledge?

A. Yes, as far as the spiral coil apparatus is concerned.

Q. 58. And with respect to the series of experiments which you understand to be referred to in this article that I handed to you?

Mr. Garrison: That question is all blind to me, if your Honor please.

Q. 59. I will clear it up for you. You read this article, which refers to certain experiments, and you made certain answers with respect to experiments as being those referred to here. Were they all done in Sulman & Picard's laboratory?

A. All that I personally conducted were.

Q. 60. And all done by you as an assistant of or employed by Messrs. Sulman & Picard?

A. Yes.

Q. 61. Your answer is yes?

A. Yes.

Mr. Neary: Examination is closed.

Cross-Examination

By Mr. Williams:

XQ. 62. How big was this spiral coil machine?

A. Possibly 12 inches long—the glass vessel was pos-

sibly 12 inches long by 4 or 5 inches in its deepest part, and one and one-half inches wide.

XQ. 63. And the spiral had to be inside that?

A. Yes.

XQ. 64. About what diameter was it?

A. The coil was possibly an inch in diameter. I am speaking from memory now.

XQ. 65. Now, you have testified, Mr. Chapman, about some things that were done in 1903 in the laboratory of Sulman & Picard, and you have described the Cattermole operations, and the treatment of the tailings of the Cattermole operations in the little spiral machine, and that part of the paper that was called to your attention refers to a patent in 1903. The last part of the paragraph I think was read to you, but I will read it again:

> "It was also found that ore particles could be temporarily suspended in the froths yielded by aqueous solutions of amylic alcohol and other substances not so readily in one of soap and not at all in those of saponin, ox-gall, or tannic acid, but for similar reasons these experiments were at that period unproductive of practical result."

Now, have you any recollection at any time of any experiments such as are referred to in that sentence?

MR. NEARY: Just a minute. I was confined to a definite period, and I think the cross-examination ought to be so confined.

THE COURT: I thought he did ask him in regard to that.

MR. GARRISON: Did you confine it to the time?

THE COURT: The question, as I understand it, is not objectionable.

MR. WILLIAMS: He said he did not know of it at the time of 1903. Now, I am going to ask him if anything as described there he recollects at any time.

THE COURT: At any time recollects as having performed those experiments?

MR. WILLIAMS: No, my question relates to the time of the experiments.

THE COURT: Having ever performed them?

MR. WILLIAMS: Yes.

THE COURT: I do not see any objection to that.

MR. NEARY: All right.

MR. WILLIAMS: I withdraw the question.

XQ. 66. Your attention was called to certain descriptive matter in your handwriting in a notebook of the Sulman & Picard laboratory where you were employed. I note that the preceding page gives the date February 9th, 1903. Does that represent the period when they started the work?

A. Yes.

XQ. 67. It gives the title "Scammel Oil Process." In that process what quantities of oil were used?

A. 200 to 400 per cent of oil to the amount of ore present in the test.

XQ. 68. That is from two to four tons of oil for every ton of ore?

A. Yes, that is the proportion.

XQ. 69. Now, this testing of blast furnace oil was done —I see the words "Rough Tipping Test"— in what manner?

A. In an ordinary glass cylinder with a suitable glass top. This glass cylinder would be possibly four to four and a half inches in diameter and twelve inches high.

XQ. 70. And what did you do in carrying on that tipping test?

A. After thoroughly cleaning the glass vessel, this for the purpose of preventing oil sticking to the sides of the glass, as in some of these exhibits here, we poured in water, generally acidulated water, and in that water placed as a rule 100 grams of ore crushed to around 60-mesh. The proportion of water to ore was in the neighborhood of five or six to one, usually. Upon the water surface we used to place about 100 grams of a thick residual oil and place a stopper in the top of the vessel and slightly revolved the ves-

sel in a vertical axis in order to bring about a contact of the layer of oil with the sulphide mineral of the ore. It was a matter of trial as to exactly how many tips you would give, but if the oil gave the appearance of being overladen with mineral, the operation was stopped, the oil removed, and a fresh layer of 100 grams of oil was placed on, and the operation continued.

This might proceed for three or four minutes on oil. The oil was thinned down by dilution with a thinner oil, such as kerosene—

MR. DAVIS: May I interrupt? I think I can shorten the thing if I say that it was never the thought of the defendant, and the defendant does not contend that this notebook and your reference to blast furnace oil was a reference to it in the use of any such process as is involved here. It was merely to show that they had blast furnace oil in the laboratory, and Mr. Sulman knew of that substance as an agent.

MR. GARRISON: But not a flotation agent, not an air-flotation agent.

MR. DAVIS: Not in the sense we are discussing—not as an air-flotation agent.

MR. NEARY: This process was an improvement on the Elmore oil-buoyancy process; there is no doubt about that.

MR. WILLIAMS: And the sole purpose of the operations that he carried on was to endeavor to procure the flotation of minerals by buoying it up with a large amount of oil, in order to entrap it and carry it and float it.

MR. NEARY: Just as they did in the Elmore buoyancy process.

THE COURT: That is another process.

MR. GARRISON: They merely wanted to show that this was in the laboratory—like prussic acid.

By MR. WILLIAMS:

XQ. 71. What does your notebook show as to whether

or not this sample of blast furnace oil was tested or accepted or rejected?

A. I noted "Oil broke up badly, sinking into tails." This oil was therefore totally unsuitable for the Elmore or the Scammel process.

THE COURT: What is the other process?

THE WITNESS: The Scammel process.

THE COURT: What sort of a process is that?

MR. WILLIAMS: That was another of these oil-buoyancy processes.

MR. GARRISON: He says where they used a large amount of oil.

MR. DAVIS: He used the names of Elmore and Scammel synonymously, meaning the same thing.

MR. GARRISON: He described it in his opening as a rafting, the lifting up or buoyancy of the oil.

(Witness excused.)

MR. DAVIS: Now, if you are ready to cross-examine Mr. Stevens, I have no further witnesses.

MR. GARRISON: We have not gone over those documents yet. Can not we omit them for the present?

MR. DAVIS: If your Honor please, we will be through after Mr. Stevens' cross-examination.

THE COURT: He is your last witness?

MR. DAVIS: Yes. We want to reserve the right over the week end to put in documentary exhibits; and also this question is still open, of the admissibility of the treatise.

We have installed near the Bangor House a laboratory-sized mill-type Minerals Separation machine, and a laboratory-sized mill-type pneumatic machine; and we should like very much if your Honor could go there this afternoon and look at them. I think that is better than to have the rebuttal case start, and be interrupted by the week end.

MR. GARRISON: All right; devote an afternoon to that.

THE COURT: You would not have any testimony on rebuttal this afternoon on that plan.

MR. DAVIS: That would be the plan. I just suggest that.

THE COURT: Let me ask, gentlemen, can you finish the case next week?

MR. WILLIAMS: We have every expectation of doing so.

MR. GARRISON: We have four full days.

THE COURT: If necessary, we can sit on Saturday.

MR. WILLIAMS: We have every expectation of being able to do so.

THE COURT: With that partial understanding, I would like to finish the case next week.

MR. GARRISON: We would all try to do so.

THE COURT: With that partial understanding we will do that and your rights are reserved on this other matter, Mr. Davis.

MR. DAVIS: Yes. And if we want to introduce a statement as to what was done by this demonstration—

MR. NEARY: The demonstration tomorrow?

MR. WILLIAMS: We might after luncheon proceed with the cross-examination of Mr. Stevens.

MR. GARRISON: The Court will be up at the Bangor House and the stenographer can be there, and we can raise the question there. The Court does not have to be in the court room for that.

THE COURT: No.

MR. GARRISON: We will go to the demonstration at whatever time you say, and while we are up there, we will say whatever we have to say about Stevens, and if you have Stevens around, you can put him on the stand.

MR. DAVIS: Does that suit your Honor?

THE COURT: All right, I will be there at 2:30 o'clock. We will suspend then until that time.

SIXTH DAY

Boston, Mass.,
Saturday, June 30, 1923, 10 o'clock A. M.

DEMONSTRATIONS ON BEHALF OF THE PLAINTIFF
at
104 Longwood Avenue, Roxbury, Boston, Mass.

Present:
The Court, and counsel as before noted
10:45 A. M. Standard Time

ARTHUR HOWARD HIGGINS was called on behalf of the plaintiffs, and having been duly sworn by the Court, testified as follows:

DIRECT EXAMINATION

By MR. WILLIAMS:

Q. 1. I will not ask you now, Mr. Higgins, to state your qualifications, but we will proceed immediately to have you describe the tests or experiments that you propose to offer at the present time. Please describe in detail what you are going to do first?

FIRST EXPERIMENT

A. First, I am going to make comparative tests with two mineral-frothing agents, one, oleic acid, and the other, phenol. In the case of the oleic acid, 600 grams of Broken Hill tailings, crushed through a 100-mesh, 1800 cc. of water; 0.7 cc. equal to 0.6 grams of oleic acid; 6.6 cc. of sulphuric acid which is equal to 12 grams of sulphuric acid; the temperature of the mixture being about 45 degrees C. The mixture will be agitated in a Gabbett mixer for about five minutes at about 850 revolutions per minute.

Q. 2. What will be the proportion of oleic acid to ore?

A. .1 per cent., or two pounds to the ton.

Q. 3. What apparatus will you use for this experiment? Please indicate it for the Court.

A. A slide Gabbett.

Q. 4. Upon which I now have my hand?

A. Yes.

Q. 5. Now, will you proceed with the experiment?

A. On stopping the agitation, the froth which comes up to the surface will be removed by sliding the upper portion of the Gabbett. That will be filtered and washed with 1000 cc. of warm water, divided into three portions, and the filtered concentrate after such washing will be returned to the Gabbett with a fresh charge of water containing the same amount of acid and re-agitated, when a second froth will be formed.

Q. 6. Now, will you do the experiment?

MR. DAVIS: That is hot water?

A. That will be water of the same temperature—45 degrees C.

Q. 7. And when you say a fresh charge of acid, what acid did you mean?

A. Sulphuric acid.

Q. 8. Will there be any more oleic acid added at any time after the beginning of the first operation?

A. No, there will not.

MR. DAVIS: Let us name them as they go in.

THE WITNESS: That is the sulphuric acid.

By THE COURT:

Q. 9. What went in there first?

A. Plain water. That is a little agitation to mix the acid and the water. This is the ore (indicating). It is crushed to 100-mesh. The ore is now added to the mixture of sulphuric acid and water.

By MR. WILLIAMS:

Q. 11. Is that the full speed?

A. Just about that.

By THE COURT:

Q. 12. Will you say what that is?

A. This is the oleic acid (adding oleic acid).

Q. 13. How much?

A. 0.7 cubic centimeters.

By Mr. Williams:

Q. 14. Is this Broken Hill ore?

A. Broken Hill tailings. The temperature is just over 42 degrees C.

Q. 15. That is the temperature after you have put everything in?

A. Yes.

Q. 16. Taken at the present time?

A. Yes.

Q. 17. Is that all froth inside?

A. Yes, you can see the line inside.

By The Court:

Q. 18. The froth extends down to there, does it?

A. Just down to about there (indicating).

Mr. Davis: So far as going on with the repetition of this same experiment is concerned, and assuming that Mr. Higgins is going to testify that the thing will happen which he just said will happen, we are not going to dispute that, and unless you think it would further enlighten yourself, Judge Peters, to see this same thing over again, we are wasting time.

Mr. Kenyon: It ought to be done.

Mr. Williams: If it is conceded that what the witness has testified to will happen, there is no occasion for doing it over again.

The Court: I think not.

Mr. Garrison: You concede that?

Mr. Davis: I do concede that.

By Mr. Williams:

Q. 19. This is to stop now. Will you describe your next experiment?

A. Do you want me to say there is a froth there?

Q. 20. You have said what will happen, did you not?

A. Yes.

SECOND EXPERIMENT

THE COURT: Now, your next experiment.

THE WITNESS: The next experiment consists of 600 grams of Broken Hill tailings crushed through 100-mesh, with part of the same sample of Broken Hill tailings which will be taken. 1800 cc. of water; 1.8 grams of phenol; 6.6 cc. of sulphuric acid; the mixture being at a temperature of about 45 degrees C. The agitation will be for a period of five minutes, at about 850 revolutions per minute. After stopping the agitation the froth will be removed, the filtrate broken up thoroughly and washed with 1000 cc. of warm water, the warm water at about 45 degrees C., in three portions, and the filtered concentrate will be returned to the Gabbett mixer with 1800 cc. of water containing 6.6 cc. of sulphuric acid, at about the same temperature, 45 degrees C., and re-agitated, when it will be found that the froth will not be re-formed, that practically the whole of the concentrates will be left in the bottom of the Gabbett.

Q. 21. Then, as I understand you, you will form a concentrate with phenol; you will wash this concentrate; you will put it back in the machine, and you will fail to form any substantial concentrate; is that the idea?

A. Yes, in the froth.

Q. 22. And the amount of phenol that you use, will it or will it not go entirely into solution?

A. It will go entirely into solution.

Q. 23. Will you use the other machine?

A. Yes. The water is now put into the machine.

By MR. DAVIS:

Q. 24. It is understood, Mr. Higgins, that the agitation will be the same in both cases?

A. Yes, the agitation will be the same, as near as we can possibly get it the same. There may be a slightly different amount of slip in the two belts, but I prefer to use the next one, so that it is already clean, rather than use one which might have a suspicion of having a trace of oleic acid left in it.

MR. DAVIS: With that understanding, we are willing to agree that what you say will happen, will happen.

MR. WILLIAMS: I think we ought to do the first part of the experiment, having shown a mineral-froth produced by an insoluble frothing agent in the Gabbett, I would like to show the Court the mineral-froth produced in substantially the same apparatus under substantially the same conditions with a wholly soluble agent.

MR. DAVIS: I should like to see that.

THE WITNESS: The water is rather rusty. I am going to have it thrown out and a new lot put in.

By THE COURT:

Q. 25. Say what you do?

A. I had the water that we first put into it thrown away, because it contained too much rust.

Q. 26. What is in there now?

A. Only water.

Q. 27. As you go along, please state what you put in there, otherwise it won't mean anything to me.

A. It is forty-seven and one-half degrees C. Sulphuric acid is now added. The same amount of sulphuric acid as was added in the other experiment is now put into the mixer and agitated to mix. The phenol in a melted condition is now run into the mixer, 1.7 cc. in quantity.

By MR. DAVIS:

Q. 28. How much phenol?

A. 1.7 cc.

Q. 29. What is that from?

A. It is as near as we can get it 1.8 grams. It is .1 per cent. on the amount of water present.

By MR. WILLIAMS:

Q. 30. What you are reproducing is the proportion specified in the example of the patent, except that you have phenol instead of amyl acetate; is that correct?

A. Yes.

MR. DAVIS: I want the record to show what the percentage is on the weight of the ore, or pounds per ton of ore.

MR. GARRISON: He will give it to you.

THE WITNESS: Six pounds per ton of ore.

Q. 31. Or 0.3 per cent.; is that right?

A. Yes, 0.3 per cent. The ore is now added to the Gabbett. The ore takes in a certain amount of air with it. It will take a little time for that air to escape.

By MR. DAVIS:

Q. 32. Mr. Higgins, is there any particular reason why you put the oleic acid in after the ore in the first case, and the phenol in before the ore in the second place?

A. Yes. I am following the instructions in the two patents, 835,120, and the patent in suit.

Q. 33. It would not make any difference, would it, to the result?

A. No, it does not make any difference. The speed has been adjusted now, so that it is within two per cent of the same speed as the other machine. I will stop now. (Stopping operation.)

By MR. WILLIAMS:

Q. 34. I would like you to see it in the light, your Honor.

THE WITNESS: You can not see the bottom of the froth yet.

THE COURT: It is right below.

MR. WILLIAMS: It takes a little while to settle and drain.

By MR. DAVIS:

Q. 35. As I understood Mr. Higgins, these two operations were identical, with the exception of that in the first one you used a small quantity of oleic acid, and in the second one you used a small quantity of phenol?

A. Yes. The two operations were identical.

Q. 36. And the two froths are identical in appearance?

A. No. They are not.

Q. 37. You do not agree with that?

A. Not identical.

Q. 38. And as I understand it, the first operation was

supposed to be a reproduction of the first patent, that is, 835,120?

A. It was.

Q. 39. And this second operation is supposed to be a reproduction of the second patent?

A. Yes.

Q. 40. The patent in suit?

A. Yes.

By Mr. Williams:

Q. 41. Now the ores are the same?

A. Yes.

Q. 42. And the froth—

A. The ore in each case is part of the same sample, crushed at the same time and weighed out in separate portions.

By The Court:

Q. 43. How does the froth differ, Mr. Higgins?

A. There is a different appearance altogether, as you look at it through the glass sides. This one shows light brown patches in it.

By Mr. Garrison:

Q. 44. Which one is that?

A. The phenol froth. It shows light brown patches of the very finest mineral. The other one does not show that. It is more uniform in color; whereas this solution froth is more variegated.

By Mr. Williams:

Q. 45. Now, as the defendant has agreed that what has been said would happen, would happen if you were to take this froth and wash it, and then put back the washed concentrate into the cell, we will go on with the next experiment, and not proceed further with this.

THIRD EXPERIMENT

Q. 46. In the first place, before describing the experiment, will you describe the machine in which you are going to do the first experiment; what kind of a machine is it?

A. I have two sub-aeration machines with glass sides and without launders at the top for removing concentrates, set up side by side and running from the same shaft, so that they get the same agitation as far as is possible. One machine is nearly twice as deep as the other machine. We shall put in charges of ore into the machines, equal in weight, roughly 500 grams of the defendant's ore, and crushed from 10-mesh in the laboratory ball mill for 30 minutes. That will make the ore roughly all through 100-mesh.

Q. 47. What is the operation of the sub-aeration machine represented in these small machines before us; in the first place, does it contain a rotating impeller?

A. Yes, the machine contains a rotating cruciform propeller having blades set at 45 degrees so as to give upward throw to the liquid being agitated. Above the agitator there is a baffle plate consisting of eight radial baffles held on a frame. This serves to destroy to a great extent the vortex formed in the mixer without such baffles, and allows air to be drawn in through a pipe, which debouches towards the agitator, towards the center.

Q. 48. Where is that pipe?

A. Coming out of a little hole. You can see it down about here (indicating). During the operation of this machine, the ore is subjected to agitation in the pulp, and at the same time the streams of air in the form of small bubbles pass through it and carry up the concentrate to the top in the form of a froth. Normally the froth overflows the lip of the vessel into a launder. As I have said the launder is not present because we do not intend to remove any concentrates.

Mr. Davis: I should like to know what the purpose of this is, Mr. Williams. These sub-aeration machines are not brought in by us, and why are they brought in at all, that is what I would like to find out.

Mr. Williams: Because they are standard machines of the art, and because they illustrate a type of aeration wherein the air enters from below, instead of being drawn in from above—

MR. DAVIS: I do not see how that is involved; that is, I do not understand whether you say that that is the operation of your second patent in suit, or what it is.

MR. WILLIAMS: This is the sub-aeration machine. The Callow cell is a sub-aeration machine. The Gabbett agitator is a supra-aeration machine in which the air is drawn down from above. This resembles the Callow cell to the extent that the air is drawn in from below, or forced in from below, and I am giving an example of a type of machine which is standard in the art and has been used.

MR. DAVIS: Since when?

MR. WILLIAMS: Which has been used for the past eight or ten years, as it originated about 1910.

MR. DAVIS: That is after the patent in suit.

MR. WILLIAMS: Yes. That is the purpose. We show the sub-aeration operation which is characteristic of the Callow cell.

MR. DAVIS: I understand that.

MR. WILLIAMS: And further than that, the first patent discloses a machine known as a supra-aeration machine wherein the air is liberated. This differs from that in that the air is forced in or drawn in.

MR. DAVIS: I object to this demonstration, if your Honor please, for the reason that it illustrates nothing that existed prior to the patent in suit, and because it is consequently irrelevant.

MR. WILLIAMS: It is not to show prior art. It is to show a further use of the process of the patent in suit.

MR. DAVIS: But it is not charged that we use it, is it?

MR. WILLIAMS: You use sub-aeration.

MR. DAVIS: But we do not use these machines. We use the Callow cell.

MR. WILLIAMS: You use sub-aeration machines. This is a type of sub-aeration machine wherein mechanical

agitation is employed. We will use this, and we propose to show that the theories that have been put forth as to a bubble column are untenable theories, of no value and no importance whatsoever. It is one of the things that we shall use in presenting that argument.

THE COURT: You can go ahead, and if it does not appear to have any bearing, we will strike it out later.

Q. 49. Go ahead, Mr. Higgins.

A. I have not finished the description. Two grams of lime were added to 1000 grams of ore, that is, four pounds per ton, during the grinding, so that the lime had a proper chance to be dissolved, and in the machine 0.1 per cent solution of X-cake will be added, such as to give 0.44 pounds of X-cake per ton of ore.

Q. 50. Now, what will be the difference between the two machines, if any, in the processes carried on in the two machines?

A. In the taller machine there will be admitted more air than in the shorter machine. That will show in the taller machine a greater depth of froth than in the short one.

Q. 51. On the suggestion of Judge Garrison, what are you going to show now, preliminary to the operation?

A. I now insert an upper baffle. The effect of rotating the agitator in such manner that air is not drawn down from the surface. (Letting all the air out.) The bubbles occasionally may travel down from the surface.

Q. 52. Will you run up to top speed?

A. Yes. A few bubbles are going down.

Q. 53. That is too fast. A little air is being drawn down from the top, is it not?

A. Yes.

Q. 54. Now, in the normal operation of the introduction of air such as will be carried on in this apparatus, the tall apparatus, can you repeat that now with plain water?

A. Yes. There is no air liberated from the solution, as the propeller is running round. Occasionally bubbles are drawn down from the surface. As you increase the speed the only tendency is to draw more air down from the top. In normal

operation the pipe is open and the air is let in.

Q. 55. The air is drawn in from the atmosphere?

A. Drawn in from the atmosphere.

Q. 56. By the suction of the impeller?

A. By the suction of the impeller. (Machine slowing down.) If you want to see it as it actually will run, I will remove the upper baffle (removing upper baffle). The upper baffle was for the purpose of destroying vortex, more than it is normally destroyed, so as to see the effect of the agitation. The air is now drawn down from the vortex. Opening the pipe does not make very much difference.

Q. 57. Now you have supra-aeration and sub-aeration?

A. Yes. (Two machines in operation.) The ground ore is now replaced in the machines. The level of the pulp in the two machines will be made the same height. Water has been added, and the level is now the same in each machine. (Machines working.) To each machine is added 110 cc. of X-cake solution, containing one part of X-cake in a thousand of water. The X-cake is added to the other machine, in equal quantity.

MR. TAGGART: What is the speed now?

THE WITNESS: It is a low speed to keep it mixed. The speed is now raised to the normal speed of operation, about 1600 revolutions per minute. The air pipes feeding the air to the bottom of the impeller in the machine are now opened. The air pipe in the smaller machine is choked up. I am afraid we can only show the operation by cutting off some of the air in the taller machine. You will notice as it is cut off the froth decreases in body. Now, the air pipe is full open it increases again. We have increased the speed a little. The effect of increasing the speed is to increase the amount of air going in. At an intermediate position of the air valve the froth decreases again, and when fully opened again, increases. That is all I have to say about this.

Whereupon, at 11:45 A. M., Standard Time, adjournment was taken until Monday, July 2, 1923, at 2 o'clock P. M.

SEVENTH DAY

Bangor, Me., July 2, 1923,
2:00 o'clock P. M.

TRIAL RESUMED.

Met pursuant to adjournment.
Parties present as before.

MR. DAVIS: If your Honor please, I have this one witness, an expert in the British patent practice, Mr. Lawrence Langner.

LAWRENCE LANGNER, called as a witness on behalf of the defendant, being first duly sworn, testified as follows:

DIRECT EXAMINATION

By MR. DAVIS:

Q. 1. What is your occupation, Mr. Langner?

A. I am a Fellow of the Chartered Institute of Patent Agents in Great Britain, and practice British and Foreign Patent Law.

Q. 2. What experience have you had in the practice of British and Foreign Patent Law?

A. I have been in the practice since 1905, and I have——

MR. GARRISON: We will agree he is qualified to testify with respect to the British Patent Law.

Q. 3. Have you there a copy of the British Patent No. 2359 of 1909?

A. Yes.

MR. DAVIS: That, if your Honor please, is the British patent corresponding to the United States patent in suit. That is the British patent on which it is said to be based.

Q. 4. Is that a patent for the use of all organic mineral-frothing agents in solution?

A. No.

Q. 5. Why not?

MR. GARRISON: Well, if your Honor please——

THE COURT: I suppose he is giving the British law on the subject, don't you?

MR. GARRISON: I do not know. It seems to me he is merely telling us what he thinks the patent means.

THE COURT: I thought perhaps the question was not perfectly well advised.

MR. DAVIS: I think so, too. That is, the next question really brings out the point of the British patent law, and I think if you will wait until that is answered, you probably——

THE COURT: I take it you are by him attempting to prove what is the British law.

MR. DAVIS: Yes, sir.

MR. WILLIAMS: Now, the first objection with reference to that British patent is that it is wholly irrelevant to any issue herein, because it did not become a patent until about April or May, 1910, because the complete specification, which is the only document that states the claims in a British patent, was not filed until June 28, 1909, and not accepted until March 1, 1910. The document—

THE COURT: Now, excuse me. Those are detailed objections. Suppose we hear the testimony as to the British law from this expert, and then decide later whether it is applicable or admissible under any phase of the case.

MR. WILLIAMS: The thing that I wish to present does not call for a consideration of British law. The provisional specification was filed, and that appears from the face of the patent, on February 1, 1909.

MR. GARRISON: That is our patent.

MR. WILLIAMS: Thereafter, the application for the patent in suit was filed on the 30th of April, 1909, and it contained the oath of the three joint inventors, sworn to in England on April 20, 1909. Now, under the International Convention, the provisional specification which was filed on February 1, 1909——

THE COURT: Where was that filed?

MR. WILLIAMS: In England.

THE COURT: Yes.

MR. WILLIAMS: Under the International Convention we are entitled to refer to that as filing date, just as though we had filed in this country, and so that carries our legal date of invention back to February 1, 1909, although we did not file in this country until April 30, 1909.

Now, that is the full extent of the use that we make of this British patent. Everything else following that provisional specification, which was filed February 1, 1909, occurred after our rights in this country had crystallized, and they were merely the things that the patentees did for the purpose of putting in form the monopoly for England; the first step being the filing of the complete specification on June 28, 1909. Now, the point that we make is that the scope of this British patent, founded upon the complete specification which was filed after the application in this country is a matter of no moment and no relevancy whatever. If we are going to go into the subject of British law, to find out what that provisional specification gave to the inventors, we are going into a subject that is not in any manner germane to this controversy, because we are concerned only with the construction of the American patent. I raise that objection, to exclude from the case a wholly unnecessary matter, to wit, what happened in connection with these proceedings in England subsequent to the only thing that we rely upon, to wit, the filing of the British provisional specification.

MR. DAVIS: I do not think Mr. Williams understands what I am driving at in this proof. We allege in our pleadings these three gentlemen, who filed the British application upon which the American patent in suit is based, knew that they were not joint inventors of the broad invention, that is, of a soluble frothing agent broadly; that they knew that soluble frothing agents had been invented individually by others; and in support of that point I propose to show that in Great Britain they

represented that to the Patent Office and stated that they were not the inventors jointly of the broad idea.

Now, I would not require the testimony of Mr. Langner on that but for this single point: That in the claim of this patent, the British claim, the words are used:

"Mineral frothing agent of the kind described."

And in the specification is the explicit disclaimer, as follows:

"Further we do not claim the inventions claimed in the prior patents No. 26,852 of 1908 and No. 28,173 of 1908."

Now, I wanted to show by Mr. Langner that that is the practice in the British Patent Office, to put the disclaimer in the specification, and yet to allow a claim which if it were not read with the specification might seem to cover the thing more broadly.

THE COURT: I think I will hear it, subject to objection.

MR. DAVIS: I will rephrase the question:

Q. 6. Mr. Langner, I call your attention to the British Patent No. 2359 of 1909, and to the words of the claim:

"Slightly acidified water containing in solution a small quantity of a mineral-frothing agent of the kind described."

And I also call your attention to the last words of the specification, as follows:

"Further we do not claim the inventions claimed in the prior patents No. 26,852 of 1908 and No. 28,173 of 1908."

Will you please say whether it is the practice in the British Patent Office thus to insert disclaimers in the specification, which specification contains claims in language which does not in itself contain the disclaimer?

A. It is.

Q. 7. And is the effect of the disclaimer in the specification to limit the meaning of the language of the claims so as to exclude the disclaimed subject matter?

A. Yes. You have to subtract the disclaimed subject matter from the claim.

Q. 8. Is it possible under the British law for a person who is not the first and true inventor, but who is an importer of the invention, to obtain a valid patent for the invention as a communication from abroad?

A. It is.

Q. 9. Where an inventor makes an invention in England, and being in England, communicates it to a party in England, can that party secure the grant of a valid patent for the communicated invention?

A. No, he cannot obtain a valid patent.

Q. 10. Why not?

A. Because under the law, in order to secure the grant of a patent on an invention as a communication, the communication must be communicated from abroad.

Q. 11. Where a joint invention is made by a number of inventors in Great Britain, and one of them thereafter discovers a specific mode of carrying the invention into effect and communicates it to his co-inventors from abroad, may his co-inventors then obtain a valid patent upon the broad invention and also the specific mode of carrying it into effect in their own names?

A. They can.

Q. 12. And can they do that without stating that the invention is in part communicated from abroad?

A. They may or may not do so at their option.

Q. 13. That is, they may obtain a valid patent, either with or without stating that a part of it was communicated from abroad.

A. That is correct.

CROSS-EXAMINATION

By MR. WILLIAMS:

XQ. 14. Suppose an inventor, while in England, communicated an invention to some corporation, we will say, and thereafter went abroad and during his absence abroad the corporation filed an application for that invention in its own name, stating that it was a communication from this person, and giving his residence abroad; would that, under British law, result in the granting of a valid patent?

A. In my opinion it would not.

XQ. 15. Have you any authority for that?

A. Yes, I can refer you to three or four authorities which I will be glad to read to you.

XQ. 16. Just give the reference to them, or, as you please.

THE COURT: Have you a synopsis?

THE WITNESS: Yes.

THE COURT: Better read that also.

A. Yes, I have a synopsis:

"A communication made in this country by one British subject to another of an invention, does not make the person to whom the communication is made the first and true inventor within the meaning of the Statute of Monopolies."

That is an abstract from Terrell on Patents, Sixth Edition, London, 1921, page 17.

This is an abstract from Patent Law and Practice by Frost, Third Edition, London, 1906:

"A communication made in England by one British subject to another of an invention does not make the person to whom the communication is made the true and first inventor within the meaning of 21 James."

That is the Statute of Monopolies.

XQ. 17. You did not give the page there in Frost.

A. Volume I, page 18.

"So as to enable him to obtain Letters Patent for the invention in his own name alone."

This is an abstract from Fletcher Moulton on Patents the page of which I will give you in a moment. It is not needed here.

"But if the invention is made by a person in this country [that means Great Britain] the person to whom it is made is not the true and first inventor."

I should add that under Section 1, Sub-section 1, of the Patents and Designs Act of 1907 "an application for a patent may be made by any person who claims to be the true and first inventor."

XQ. 18. I have listened for and have not heard the specific point that I put to you, where, after the communication, the communicator goes abroad, resides abroad, and the person to whom it has been communicated applies for a patent as a communication from this person then residing abroad.

A. Mr. Williams, you said that the communication was made in England. All those points refer to the case where the communication was made in England. In such case the patent is invalid if taken out as a communication from abroad.

XQ. 19. But not any one of those cases comes to the condition that I have put to you, that, after the communication, the communicator went abroad, and that while he was abroad the patent was applied for in the name of the person to whom the invention had been communicated.

A. I do not know whether the inventor went abroad in those cases, but it is immaterial, because the law in England is perfectly plain. You can either have a patent because you are the true and first inventor, that means because you invented it psychologically, or you can have a patent because you were clever enough to get it from some foreign country. But if the information has been imparted from an inventor in England to the company in England, the company in England has neither invented it nor has it obtained it from a foreign country.

THE COURT: Do you want to elaborate that question any, and if so, I think you could make it clear when a communication was made and where. That is, I take it before the man went abroad, and made in England, is that true?

MR. WILLIAMS: Yes, I thought I made that clear.

THE COURT: The second question did not make it clear nor authoritative.

XQ. 20. Then in your opinion these authorities, that you have cited, maintain this proposition, that if a man who invents something communicates it to a company while he is in England, and he is at that time a resident of England, and thereafter goes abroad and resides abroad, that the person to whom it was communicated has no right to take out a

patent, to apply for patent in England, as a communication from this person then abroad?

A. Yes, because it was not in fact a communication from abroad. It was a communication made in England.

XQ. 21. And you do not expand your understanding of the law to include the case of a communication made at some time, and at some place, and in England, from a person then residing abroad?

THE COURT: But not being abroad.

XQ. 22. And then being abroad at the time of the application, but not at the time of the communication.

A. The question is not very clear to me, Mr. Williams.

THE COURT: I think you have asked the question three different ways, Mr. Williams.

XQ. 23. To get down to the simple principle, the man residing in England, and while residing in England, communicates an invention to a company.

THE COURT: That is different from the last time you put it.

MR. WILLIAMS: He then goes abroad and resides abroad.

THE COURT: Takes up his residence abroad.

XQ. 24. Takes up his residence abroad. While he is residing abroad, the company files an application for a patent for that invention, which was communicated to it by this inventor who is now abroad, although the communication was made at the time that the inventor was residing in England?

A. I do take that into consideration, Mr. Williams, and I say that the consideration for the grant of a valid British patent fails, because the English company cannot be said to be an importer of this invention from abroad, when it actually had possession of the invention from the man when he was located in England.

XQ. 25. Let us assume that the English company owns the invention at the time that it files the application.

A. That makes no difference, because the mere owner-

ship of an invention in England does not entitle you to apply for a patent, without being the true and first inventor.

MR. DAVIS: Mr. Langner, you were going to give the reference to Fletcher Moulton, and the page reference. Did you get it in?

THE WITNESS: Page reference, Fletcher Moulton on Patents, 1913, page 74.

XQ. 26. Where a British application is made as a communication from abroad, the applicant may be a company, that is right, is it not?

A. That is correct, yes.

XQ. 27. The applicant for a patent which is filed as a communication does not need to be the inventor in the sense of the United States laws? I thought you had said that. I am just putting it to you perhaps a little differently.

A. I am trying to think of the United States laws, to answer that question.

THE COURT: I do not think you ought to ask him about the United States laws, unless he knows about the United States laws.

MR. DAVIS: I think Mr. Langner does know, but I suggest the question ought to be reframed.

THE COURT: I think you ought to confine it to the British laws. You can use your own interpretation of the American law in your question.

MR. WILLIAMS: I will withdraw the question.

XQ. 28. Where a British application is filed as a communication, it is not necessary to state, is it, from whom the invention was communicated?

A. It is not necessary, but it is the practice to do so.

XQ. 29. I will put to you this case, Mr. Langner: Suppose an inventor had made part of an invention, had started it, you might say, while in England and communicated it to a company who was the owner of the invention; suppose thereafter he went abroad and resided abroad and sent some further information which completed the information as to the invention. Could the company, while he was residing

abroad, take out a patent as the applicant, naming him as the communicator, and get a valid patent?

A. As to matter which he sent from abroad, yes. As to matter which he communicated in England, no.

XQ. 30. But suppose they were inseparable, one was merely the carrying forward of the other idea?

A. It is almost impossible to answer that question without your defining more clearly what is meant by "carrying forward of the idea." If you refer to a broad conception, and to a specific form of carrying it out, my answer is that as to the broad conception which had been communicated in England, a valid communication patent could not be obtained, but as to the specific mode of carrying out the nature of the invention communicated from abroad, a patent of that scope could be obtained by the English company.

XQ. 31. Will you explain what a provisional specification is in the British law?

A. The provisional specification is the document in a British application which ascertains the nature of the invention.

THE COURT: Ascertains or discloses?

THE WITNESS: The word you would use here is discloses. That means in the English practice, we use the expression "Ascertain the nature of the invention." That means to say, describes the ideas, but does not necessarily have to describe how the invention is carried into practice. It was something like a caveat in the United States practice some years ago, where you just set forth the ideas, but did not say how they were carried out into practice.

XQ. 32. But at the same time you might say how it is carried out into practice?

A. You might say so. You may make it as complete as you please.

XQ. 33. And it contains no claim or statement of claim?

A. No, it does not contain any claim.

XQ. 34. And what is the effect, under British law, of filing a provisional specification, as to date of invention?

A. It fixes the date, the effective date of invention.

XQ. 35. And it fixes it so effectively that if the inventor had invented it years before, he could not go back of the date of the actual filing of that specification, does it not?

A. Yes.

XQ. 36. So that the practice is, is it not, whenever an invention, in England, is in such shape as to enable to file the provisional specification, to file it very promptly, if you have any intention of patenting the invention?

A. That is the practice.

XQ. 37. What is the period that you allow for completing?

A. Nine months.

XQ. 38. And some time before the expiration of that nine months, you file a complete specification, is that right?

A. Yes.

XQ. 39. And in that complete specification you put your claim or statement of invention, is that right?

A. Not entirely. In the provisional specification you set forth the broad idea. In the complete specification you describe how it is carried into effect, how it is carried out, and also you put in your claims.

XQ. 40. After that complete specification has been filed, what happens?

A. The application is examined and a search as to the novelty of the invention is made.

XQ. 41. By the Patent Office Examiners?

A. By the Patent Office Examiners.

XQ. 42. Now, can a British patent be anticipated under British law by a document that was not published until after the filing of the application for the British patent?

A. No, it cannot be anticipated.

XQ. 43. When does publication take place of a British provisional specification?

A. Upon the publication of the complete specification, which takes place about three weeks after the date of acceptance.

XQ. 44. And, of course, the acceptance of the complete specification is the action of the Patent Office, after it has been satisfied as the result of its examination?

A. It is.

XQ. 45. And when is the patent actually issued?

A. After the acceptance of the application, the specification is laid open to opposition for two months. After that, the sealing fee has to be paid within a certain period—I think two or three months—and the sealing of the patent depends on how promptly you pay the sealing fee.

XQ. 46. What is the sealing of the patent?

A. The sealing of the patent in England is the actual applying of the seal to the patent and the mailing of the patent document to the applicant.

XQ. 47. Is it not the actual issuance of the patent?

A. The issue, yes.

XQ. 48. And when the patent is issued, twelve or fifteen months or so after the provisional specification has been filed, what is taken to be the date of that British patent?

A. The date of filing of the provisional specification.

XQ. 49. Now, in the case put to you in the direct examination, namely, a joint invention made in England and species thereunder made thereafter abroad, and communicated from abroad to the other joint inventors, as I understand it, you say two British patents may be applied for, and that both may be in the joint names of all, with or without a statement of partial communication from abroad.

A. I don't think I made that statement that two should be applied for. I said one could be applied for in the names of the two inventors who were in England, with or without naming the fact that they had received information as to the part communicated from abroad.

XQ. 50. But in such a state of facts as that with a specific invention communicated from abroad, of course an application could be filed by the company owning it as the applicant, naming the man abroad as the communicant; that is right, is it not?

MR. DAVIS: I object to that question as indefinite.

XQ. 51. If you do not understand it, I will put it again.

A. Yes, please read that. (Question repeated.) And what is the state of facts that you refer to there, Mr. Williams?

XQ. 52. I am merely isolating out a specific invention communicated from abroad.

MR. DAVIS: State what you have in mind.

XQ. 53. And I am merely asking you in that case, and I think you have said it before, whether under that condition a company in England could not obtain a valid patent, filing the application as a communication from that inventor abroad; that is true, is it not?

A. If I understand your question, you mean—if an inventor is located abroad, and a company is located in England, and the inventor makes an invention abroad, can he communicate that to the English company, and the company obtain a valid patent as a communication? The answer is, Yes. The English company can obtain a communication patent in England.

XQ. 54. Now, assume a broad invention made in England by three persons, a specific invention thereafter made abroad by one of them and communicated to a company; thereupon the company files an application as a communication for that specific invention; thereafter, the three joint inventors file an application for a patent for the broad invention: Would it make any difference in British law that that specific application was filed before the broad application?

A. Yes.

XQ. 55. Assuming that they were filed within, say, a month or within so short a time that there had been no publication.

A. Yes. It would make a difference, because the patent with the broad claims would come out later than the patent with the narrow claims. As a result, the monopoly area of the patent would be extended beyond the period of sixteen years allowed by the British law, because when the patent on the narrow invention has lapsed by reason of the expiration of the term, the invention would still be protected by the

broad claim on the later patent, and under those circumstances you would have a situation akin to double-patenting in the United States, and it would invalidate the later patent.

XQ. 56. Now, suppose the later patent contains a disclaimer of the specific subject matter of the earlier patent, that cures the situation, does it not?

A. That cures the situation, because it has narrowed the later patent.

XQ. 57. And the later patent is just narrowed by the amount that is taken off by that disclaimer, is it not?

A. It is narrowed as to the disclaimer, by the disclaimer, yes.

MR. WILLIAMS: That is all.

(Witness excused.)

MR. DAVIS: I should like to read on the record a brief stipulation that we have been able to agree on:

IT IS STIPULATED that New Zealand Patent No. 19,633 was granted to Henry Livingstone Sulman, Hugh Fitzalis Kirkpatrick-Picard and John Ballot on October 27, 1905, on an application filed June 27, 1905, and the documents identified in the certified copy of that New Zealand Patent (Defendant's Exhibit No. 55) as "The Complete Specification and Drawings as originally filed and accepted" constitute the complete specification and drawings of the New Zealand Patent as granted on October 27, 1905.

Under the New Zealand Patent Law which was in force in 1912, a patentee could file an application for leave to amend the specification and claims of a patent already granted. Under this provision of the New Zealand Patent Law (Section 23 of the Law of 1911), application for leave to amend the specification and claims of Patent No. 19,633 was filed and notice of said application was published at page 229 of the New Zealand Patent Office Journal of October 31, 1912 (Defendant's Exhibit No. 57). This application to amend Patent No. 19,633

was allowed on December 11, 1912, and notice of such allowance appears on page 312 of the New Zealand Patent Office Journal of December 12, 1912 (Defendant's Exhibit No. 58). The complete specification and drawings as originally filed and accepted (forming part of Defendant's Exhibit No. 55) constitute the specification, claims and drawings upon which the aforesaid New Zealand Letters Patent were granted, and they remained the basis of the monopoly secured by the patent for a period from June 27, 1905, the date of application, until December 11, 1912, the date that the amendment of the specification was allowed by the New Zealand Patent Office.

IT IS FURTHER STIPULATED that Defendant's Exhibit No. 55 are correct copies of the original documents of which they purport to be true copies.

MR. DAVIS: I have, if your Honor please, to offer some additional exhibits.

THE COURT: That whole file?

MR. DAVIS: Yes, may we put them in as we did before?

THE COURT: They have seen them, have they not—the other side?

MR. DAVIS: Some of them they have.

THE COURT: Show them to the other side, and if you can do it as you did before, put them in without reading.

MR. GARRISON: May I suggest that the stenographer take that they have offered all of these, and that he identify them and give them a number, and if we make no objection, they can go in, and if we do, specific ones can be ruled on.

THE COURT: Yes.

MR. DAVIS: I think that is fair and convenient, but, of course, if one should be ruled out as to which we could now complete our case—

THE COURT: You will have that opportunity to do that.

The following Exhibits were received in evidence and marked as follows:

DEFENDANT'S EXHIBIT No. 118—Froment description, translation of Froment description and descriptive matter on Froment drawings; Froment plan and Froment drawing—A.

DEFENDANT'S EXHIBIT No. 119—Writ, Statement of Claim, Particulars of Breaches, Defense, Particulars of Objections; Notice of Discontinuance in suit of Minerals Separation Limited vs. The Ore Concentration Company (1905) Limited.

DEFENDANT'S EXHIBIT No. 120—Sulman, and Picard, Higgins, etc. Reports 1903-1905; Nutter Report 1910.

DEFENDANT'S EXHIBIT No. 121—Power of Attorney to John Ballot from Minerals Separation American Syndicate (1913) Ltd., recorded in United States Patent Office June 15, 1917, in Liber J-102, page 469.

DEFENDANT'S EXHIBIT No. 122—Statement in Lieu of Prospectus filed by Minerals Separation American Syndicate (1913) Ltd.; Return of Allotments from the first of July, 1913, to the 23rd of July, 1913, of Minerals Separation American Syndicate (1913) Ltd. and Extract from Annual Return of Minerals Separation American Syndicate (1913) Ltd. made up to the 26th day of November, 1914.

DEFENDANT'S EXHIBIT No. 123—Standard Form of Plaintiff's License.

DEFENDANT'S EXHIBIT No. 124—Assignment Minerals Separation American Syndicate (1913) Ltd. to Minerals Separation North American Corporation, recorded United States Patent Office June 15, 1917, in Liber J-102, page 476.

DEFENDANT'S EXHIBIT No. 125, U. S. Patent No. 953,746 to Hoover, patented April 5, 1910—"Apparatus for Ore Concentration."

DEFENDANT'S EXHIBIT No. 126, U. S. Patent No. 1,228,183, to Corliss, patented May 29, 1917—"Flotation of Minerals."

DEFENDANT'S EXHIBIT No. 127, U. S. Patent No. 1,295,817, to Towne and Flinn, patented February 25, 1919—

"Process for Separating Ore Materials from Each Other."

DEFENDANT'S EXHIBIT No. 128, U. S. Patent No. 1,329,335, to Callow, patented January 27, 1920—"Method of and Apparatus for Concentrating Ores."

DEFENDANT'S EXHIBIT No. 129, License Agreement dated April 23, 1919, between Metals Recovery Company and Magma Copper Company, involving U. S. patent of Corliss No. 1,228,183.

DEFENDANT'S EXHIBIT No. 130, License Agreement dated August 2, 1915, between Pacific Metals Recovery Company and Magma Copper Co., involving U. S. patent of Callow, 1,329,335 (Application Ser. No. 828,805).

DEFENDANT'S EXHIBIT No. 131, License Agreement dated May 27, 1921, between Pneumatic Process Flotation Company and Magma Copper Company, involving U. S. patent of Towne & Flinn No. 1,295,817.

DEFENDANT'S EXHIBIT No. 132, File wrapper and contents of U. S. patent No. 1,099,699 to Greenway, patented June 9, 1914, "Concentration of Ores."

DEFENDANT'S EXHIBIT No. 133, File wrapper and contents of U. S. patent No. 777,273 to Cattermole, patented December 13, 1904.

DEFENDANT'S EXHIBIT No. 134, File wrapper and contents of U. S. patent No. 777,274 to Cattermole-Sulman-Picard—December 13, 1904.

DEFENDANT'S EXHIBIT No. 135, File wrapper and contents of U. S. patent 788,247—Cattermole, Sulman, Picard —April 25, 1905.

DEFENDANT'S EXHIBIT No. 136, File wrapper and contents of U. S. patent No. 793,808—Sulman & Picard, July 4, 1905.

DEFENDANT'S EXHIBIT No. 137, File wrapper and contents U. S. patent 835,120—Sulman-Picard-Ballot—November 6, 1906.

DEFENDANT'S EXHIBIT No. 138, File wrapper and contents U. S. patent 835,479—Sulman-Picard-Ballot—November 6, 1906.

DEFENDANT'S EXHIBIT No. 139—File wrapper and contents U. S. patent 879,985—Sulman-Picard—February 25, 1908.

MR. DAVIS: Now, there are still open between us this question: Mr. Williams, I think, had reserved the right to enter further objection to the Bradford deposition. I understand there are no further objections than those specified in the deposition.

MR. WILLIAMS: That is right.

MR. DAVIS: With respect to this Sulman & Picard document, I think that perhaps Judge Garrison should state on the record what he stated to you at the hotel on Saturday.

MR. GARRISON: What I desire to state in respect to the Sulman document is that whatever other use the defendant may desire to make of it, we object to any use of it as if to prove facts.

THE COURT: That is the treatise?

MR. GARRISON: That is what they call the treatise, and we call the notes.

THE COURT: Yes.

MR. GARRISON: It is a mere matter of nomenclature.

THE COURT: All right, the treatise, I will call it as you did just now. Do you claim, Mr. Davis, that is proof of the facts stated therein?

MR. DAVIS: We claim that it is the proof of knowledge by Mr. Sulman of the things which he there sets forth.

THE COURT: That is what I supposed. I do not accept it as proof of the facts alleged to be facts therein.

MR. DAVIS No, sir, if Mr. Sulman says that in South Africa they did so and so, we would expect to have him here and cross-examine him.

THE COURT: Certainly. There is no misunderstanding about that.

MR. DAVIS: There is one other thing I should like to add to the record, that is a copy of the statement of the tests on Friday, of which I handed your Honor a copy

then, and we will attach to it drawings of the two pieces of apparatus. That is only in case we ever have to repeat that demonstration, we can do so.

MR. GARRISON: Will you let us look at the drawings, Mr. Davis?

MR. DAVIS: Yes, and there is a further stipulation of facts, which our opponents have agreed to most of and we will arrive at some agreement.

THE COURT: Put them in at any time.

PLAINTIFF'S PROOFS IN REBUTTAL.

MR. WILLIAMS: Mr. Arthur Howard Higgins.

ARTHUR HOWARD HIGGINS, was called as a witness in rebuttal in behalf of the plaintiff and, being duly sworn, testified as follows:

MR. WILLIAMS: Mr. Higgins was sworn before, on Saturday.

THE COURT: Yes, but he is called again by you now.

MR. WILLIAMS: Yes, sir. Mr. Davis, will you admit that Mr. Higgins is a duly qualified metallurgical expert?

MR. DAVIS: Yes, with pleasure.

DIRECT EXAMINATION.

By MR. WILLIAMS:

Q. 1. Mr. Higgins, the earliest patent referred to by the defendant is British Patent No. 488 of 1860, to William Haynes. Have you examined that patent, and are you familiar with it?

A. Yes, I have examined this patent, and I am familiar with it.

Q. 2. Does it disclose a process wherein mineral is floated?

A. No, it does not.

Q. 3. Is it a practical process of concentrating ores?

A. No, it is not.

Q. 4. Have you carried it out in laboratory dimensions in accordance with the disclosures in the specification?

A. Yes, I have; many times.

Q. 5. Defendant's witness, Professor Taggart, testifying in regard to the Haynes patent, says:

"Subsequently it was possible to separate the oily matter containing the sulphide material from the muddy water containing the gangue by floating the material off,"

and later said that the material that floated off was the mineral. Do you agree with that statement?

A. No, I do not.

Q. 6. The next patent offered in evidence by the defendant is the Bessel Brothers German Patent No. 42, of 1877. Have you studied that patent and do you understand it?

A. Yes, I have studied this patent and understand it.

Q. 7. What is disclosed in that patent as to the amount of organic material employed?

A. The quantity of one to ten per cent.

Q. 8. And how much is that per American ton of 2,000 pounds of ore?

A. 20 pounds to 200 pounds per ton of ore.

Q. 9. Among the organic substances named in the long list in the patent, are there any substances that would be completely soluble if used in accordance with that specification?

A. No.

Q. 10. In what manner are the organic material and the ore mixed, according to that specification?

A. The crude impure graphite is mixed with the ore before wetting the mixture. That is to say, it is mixed dry.

Q. 11. What is the fact as to making that kind of a mixture with the ore in the dry condition?

A. It would be exceedingly difficult on a large scale to mix even 10 per cent with the ore dry, and quite impossible with 1 per cent.

Q. 12. Have you tried to carry out the process that is disclosed in that specification?

A. Yes, I have.

Q. 13. Have you succeeded or failed?

A. I have failed to get anything which could be called a successful result even on a small scale.

Q. 14. What is the significance of the reference to flaky material, at the end of the specification?

A. That refers to the coarser kinds of graphite and is undoubtedly an advice not to grind the impure graphite so that very fine graphite is formed. In other words, it leads one to believe that the operation would not be successful on the finest kind of graphite.

Q. 15. And has or has not your experience been of that character?

A. That is my experience.

Q. 16. What has been your experience; did you grind finely?

A. No, I took the ground graphite. I was not able to get anything so rich as 40 per cent. I was only able to get some graphite which contained 2 or 3 per cent of graphite, and that I ground through 10-mesh and 20-mesh, but there was not any difference in the behavior of the two samples. They both failed to give results with this process.

Q. 17. What kind of gas bubbles are formed in this process as disclosed in the patent?

A. The gas bubbles are bubbles of steam which, on arriving at the surface, burst.

Q. 18. We will take the second of these Bessel Brothers patents, No. 39,369 of 1886; have you studied that patent, and are you familiar with it?

A. Yes, I have studied it and am familiar with it.

Q. 19-20. Have you tried to carry it out in accordance with the disclosures of the specification?

A. No, I have not.

Q. 21. Have you had experience with other processes of that same general character, as to the generation of gas bubbles?

A. Yes, I have. This has one slight difference, that the processes that I am familiar with, demand the mixing of the ore and water before the oil is added. In this one it is the other way round; the mixture of the substance of oily mate-

rial is mixed first with the dry graphite. That with 1 per cent, which is recommended in the patent, is in my opinion an impossible thing to do on a large scale.

Q. 22. What is your experience as to procedures wherein gas liberation occurs as is disclosed in this patent?

A. That they can be carried out on a very small scale in test tubes and beakers, but as soon as one takes a larger apparatus, the size of a bucket for instance, the process becomes a failure. The only float one is able to get is a small amount of skin float on the surface of the water, which is utterly useless, in that it carries no metal worth recovering.

Q. 23. Do you regard this as a practical process of concentrating ores?

A. No, I do not.

Q. 24. I wished that question to apply particularly to the disclosures of this particular Bessel patent. Did you so understand in answering it?

A. Yes, I did.

Q. 25. The next patent offered in evidence by the defendant is that to Carrie J. Everson, No. 348,157, dated August 24, 1886. Have you read that patent, and do you understand it?

A. Yes, I have read it and understand it.

Q. 26. Have you carried out the things that are disclosed therein?

A. Yes, I have; many times.

Q. 27. Professor Taggart has testified that there are two methods of operation disclosed in that patent. Do you agree with him as to that?

A. Yes; there are two ways of carrying out the invention.

Q. 27-a. As to the first method or way of carrying out the invention, Professor Taggart stated that the treatment of cottonseed oil with concentrated sulphuric acid produced "a whitish oily mass of rather salve-like consistency." Do you agree as to that?

A. After the addition of the water to that compound, it becomes a white, not exactly oily mass, but a very sticky mass.

Q. 28. Professor Taggart says that this mass is put in the water containing a small amount of acid; do you agree with that?

A. No, I do not. Unacidified water is added to the mixture of compound and ore.

Q. 29. Professor Taggart says that the oily mass of mineral and oil is separated from the water by floating it; do you agree with that?

A. No, that is not so. The stiff mass produced after the mixture of acid and oil having been mixed with the ore, is squeezed through the hand repeatedly in a basin of water, so as to express the material through the fingers. After doing this a good many times, the sand falls away from the mass, leaving the lump in the hand, or perhaps one or two detached pieces in the basin, which are picked out. The lump of concentrate is much too heavy to float.

Q. 30. Are any bubbles introduced into the mass by the kneading operation?

A. No; on the contrary. The squeezing operation through the hand is much more likely to express bubbles just as one squeezes air out of a sponge.

Q. 31. Now, when you speak of kneading it with the hand, do you follow the exact description of the patent?

A. Yes.

Q. 32. Now, we will take the Everson second method: and, in the first place, what is the principal difference between the Everson first method and the Everson second method?

A. The principal difference consists in the place where the acid is added. In the first method, the acid is mixed with the oil. In the second method, the acid is put into the water, and the dry ore, having been oiled with the oily matter that is chosen, is put into the acidified water.

Q. 33. About what percentage of oil is prescribed in this Everson second method?

A. Roughly, 15 per cent.

Q. 34. The specification says, at page 2, line 95:

"The concentrate mass is more liquid than when a

vegetable or an animal oil or a fatty constituent thereof is used."

In this case, where paraffin oil is used. That is true, is it not?

A. Yes, I found that is true.

Q. 35. The specification says, commencing at line 99, page 2:

"In practice, the concentrate, after thorough agitation of the mass and detachment of the sand will, in this case, be preferably removed by means of a constant overflow of water from and washing out of vessel, by which overflow the concentrate will be floated off."

What is the meaning of those words "floated off" as describing that operation?

A. That the oiled mineral will be carried off in suspension in the water, and not actually floating on the top of the water. She says very clearly that the sand and mineral are merely transposed, or their relative positions are reversed, because the sand is heavier than the mixture of mineral, oil and acid. That is to say, she only wants to add enough oil to make the mineral relatively lighter than the gangue in water.

Q. 36. With that amount of oil added, what will be the relation of the weight of the mineral to the water?

A. It is still greater than the weight of the water. It sinks in the water, but sits on top of the sand.

Mr. Davis: Your Honor, I think perhaps I ought to say that there may have been a misconception of my attitude, judging from Mr. Williams' examination. This Everson patent was not brought forward as disclosing a process which was the process here in issue. It was brought forward only because it includes flotation agents. We make no pretenses that this Everson process was an air froth flotation process.

Mr. Williams: No, but your witnesses testified that it is a process of flotation, and that I contest.

Mr. Davis: Well, if you understand the situation, why, of course, I have nothing more to say, but I did not know but there was a misunderstanding.

Q. 37. Now, with the mixture of oil and metal heavier than water, but lighter than the gangue, what, in metallurgy, using the devices and methods then well known in the wet separation of ores, was the method employed to separate the mineral from the gangue?

A. On the small scale an instrument known as a batea, which consists of a somewhat conical pan——

Q. 38. Isn't that the miners' washing bowl?

A. Yes—or on a larger scale, bumping tables or even jigs.

Q. 39. And when you carried out this process, what did you use for the purpose of making the separation?

A. I used a batea.

Q. 40. What was the result of the operation of that batea?

A. The oiled mineral concentrate overflowed the edge of the batea and was caught in a suitable receptacle, and the sand remained in the batea.

Q. 41. Were there any air bubbles introduced in your operation?

A. Yes, I think there were a few air bubbles introduced during the thorough agitation which the patent called for. After the mixing of the oiled mineral with the acid water, the instructions are to thoroughly agitate, which I did, and I believe this agitation did introduce some air bubbles.

Q. 42. What became of those air bubbles?

A. Those that really got into the mixture stayed with the mixture of oil and mineral.

Q. 43. Did they produce any flotation of the mineral?

A. No sensible amount of flotation. There may have been one or two specks on the surface of the water.

Q. 44. Is this second method a process for recovering mineral by flotation of the mineral?

A. No.

Q. 45. Do either of these methods describe a practical process for the concentration of ores?

A. No.

Q. 46. The next patent offered in evidence and referred to by Professor Taggart is the British patent to Sutton, No. 24,144, of 1892. Have you examined that patent, and are you familiar with it?

A. Yes, I have examined it and I am familiar with it.

Q. 47. At the end of the description of that patent Professor Taggart says:

> "Now, this particular process was not one in which metallic mineral was to be separated from gangue, but one in which precipitate of gold, which is of course a metal, was to be picked up in water, because of the tendency of the oily substance to hang on to the gold and collected together in the mass of the oily substance and floated away."

Do you agree generally with that description?

A. Yes, I do.

Q. 48. And what kind of flotation occurs there of these particles of metal?

A. Bulk-oil flotation.

Q. 49. The next patents referred to are those of Robson and Crowder, British patent 427 of 1894, and No. 2538 of 1895. Are you familiar with those patents?

A. Yes, I am

Q. 50. Do they disclose a flotation process of concentrating ores?

A. No, they do not.

Q. 51. The next patent is to Froment, or, to be more exact, it is British patent of Henry Harris Lake, taken out as a communication from Froment, No. 12,778, of 1902. Have you examined that specification, and do you understand it?

A. Yes, I have examined it and understand it.

Q. 52. What is the disclosure in that specification?

A. The disclosure is a test tube experiment.

Q. 53. And how much ore is used in that test tube experiment which is disclosed in the specification?

A. Ten grams, or, roughly, one-third of an ounce, something less than a teaspoonful.

Q. 54. Have you carried out the process thus disclosed?

A. Yes, I have, many times.

Q. 55. What is the amount of oil that is required by the disclosure of the specification?

A. About twelve per cent.

Q. 56. And how much would that be on the American ton of ore?

A. 24 pounds per ton, roughly.

Q. 57. How about 240?

A. 240 I should have said.

Q. 58. In the first place, does this disclose a process whereby the mineral is floated?

A. No, not in the sense in which flotation is at present used; but in the sense that the mineral is made into a floating magma, it does disclose the floating of the mineral.

Q. 59. What is a magma?

A. A magma is a paste; in this case a paste of oil and mineral.

Q. 60. And what kind of a floating magma is produced by this process?

A. This process produces a floating magma of oil and mineral distended by gas bubbles, the gas being carbon dioxide.

Q. 61. How is the gas generated?

A. The gas is generated from limestone by the action of sulphuric acid.

Q. 62. And how does that resemble the second Bessel patent?

A. Very much. The only difference being that Bessel mixes the oil with the ore dry, whereas Froment puts them all together in a test tube, and shakes them up, the ore having a chance to get wet before the oil gets to it.

Q. 63. He says something, does he not, about being very careful to avoid an explosion; just generally, that is so, is it not?

A. Yes, he says, that you have to be careful, otherwise the copper pyrite would be forcibly projected outside the vessel.

Q. 64. Have you had that experience in carrying out the process?

A. Yes, I have.

Q. 65. Is the process disclosed in this Froment patent a practical process of concentrating ores?

A. No, it is not.

Q. 66. Professor Taggart, in describing the disclosure of this Froment British patent, concludes his description with the

"collection of the mineral-coated gas bubbles in the form of a coherent froth or scum at the surface of the pulp."

Do you agree with that statement?

A. No, I do not.

Q. 67. Professor Taggart refers to what he calls, "a large scale method of operation," described by Froment; are you familiar with the document to which he refers?

A. Yes, I am. It is the document known as the "Froment description."

Q. 68. Does that describe, as Professor Taggart has said, "the same kind of a thing absolutely in principle?"

A. No, it does not. There is one very material difference. Froment points out in the description that the slimes must be separated from the coarse material, because they cannot be treated by this or any other process.

Q. 69. Now, in accordance with that description, what happens first?

A. The ore is crushed and then separated in a spitzkasten, eliminating the slime which is too fine to be treated. The coarse material is then mixed with carbonate of lime and mineral engine oil. After the stuff has been thoroughly mixed, it is treated with sulphuric acid, which generates carbon dioxide and raises some of the mineral to the surface, where it floats as a skin flotation.

Q. 70. Did you see the apparatus that was sent to the Sulman & Picard laboratory in connection with the Froment description?

A. Yes, I saw it all.

Q. 71. Did you endeavor to use it?

A. Yes, I endeavored to use the mixing vat and the vat with the coil, where the carbon dioxide was generated, and the mineral supposed to be floated.

Q. 72. What was the result of what you did with it then?

A. The result was a failure. It did not indicate any practical process whatever.

Q. 73. What became of that apparatus?

A. Some years ago, I made a search for that apparatus in connection with another suit and was unable to find it, and believe that it had been scrapped some years previous to that.

Q. 74. Was a reproduction made of it for litigation purposes?

A. Yes, when we found we could not find that apparatus, the apparatus was reconstructed from the drawing.

Q. 75. And in what suit was that used?

A. In the suit, Minerals Separation, Limited, against the Miami Copper Company.

Q. 76. And did you try to work that apparatus in accordance with the Froment description?

A. Yes, I did.

Q. 77. What was the result?

A. Again the result indicated that there was no practical utility in this process.

Q. 78. What kind of flotation did you achieve?

A. Skin flotation.

Q. 79. Has the process described in the Froment patent, or the process described in the Froment description proved to be of any practical value?

A. No.

Q. 80. Just what is skin flotation?

A. The flotation of the mineral as particles on the surface of the water, roughly one particle deep, just in the same fashion in which a needle floats on water.

Q. 81. In this Froment description apparatus, why was it that these mineral particles floated on the surface of the water?

A. The bubbles of gas were not completely coated with mineral, and on arriving at the surface invariably burst, dropping part of their load, but some part of the load was left on the surface of the water.

Q. 82. And what was the condition of these mineral particles that floated on the surface; were they covered with anything?

A. Yes; they were covered with oil.

Q. 83. That reconstruction of the Froment apparatus, I think you will remember, was in the Hyde case, the case of Minerals Separation against Hyde, and carried thereby into the Butte and Superior case. Is that your recollection?

A. Yes, it is.

Q. 84. This apparatus that we have been describing, was it of a laboratory type?

A. Yes.

Q. 85. Did you ever see or ever hear of a larger-sized Froment apparatus?

A. No, I have not.

Q. 86. The next patent referred to—I have omitted one—is No. 703,905, to Elmore, dated July 1, 1902. Have you examined that patent and are you familiar with it?

A. Yes, I have examined it, and am familiar with it.

Q. 87. What type of operation is there shown?

A. It is a type of operation in which oiled mineral is made to stick to some surface, so that the surface can be removed from the pulp with the mineral stuck to it and then scraped.

Q. 88. And the particular surface here used, is the surface of what?

A. The surface of the belt, in this particular case.

Q. 89. Is that a flotation process?

A. No, it is not.

Q. 90. There were a group of patents offered in evidence by the defendant:

No. 776,145, to Potter, dated November 29, 1904,
No. 735,071, to Delprat, dated August 4, 1903,
No. 768,035, to Delprat, dated August 23, 1904.

A. Yes.

Q. 91. Have you those three patents?

A. Yes.

Q. 92. Are you familiar with those patents?

A. I am.

Q. 93. Then there is a British patent, No. 27,132 of 190 to Delprat, a New South Wales patent No. 13,939 of 1904, t Delprat?

A. Yes, I have that.

Q. 94. And a New South Wales patent, No. 13,940 o 1904, to Delprat?

A. Yes, I have that.

Q. 95. A South Australian Patent No. 6493 of 1904, t Delprat?

A. Yes, I have that.

Q. 96. And a South Australian Patent No. 6494 of 190 to Delprat?

A. Yes, I have that also.

Q. 97. Now, generally, what kind of a process is de scribed in all those specifications?

A. A process of concentrating ore in which the ore is pu into either a bath of hot sulphuric acid or of an equivalen material, the temperature being such that bubbles of carbo dioxide generate from the carbonate in the gangue, and rais the mineral particles to the surface.

Q. 98. When you say "a carbonate in the gangue," i that the kind of carbonate that Froment and Bessel dis closed?

A. No, not the same kind; another kind. The carbonat that appears to be useful in the Potter process is the man ganese carbonate.

Q. 99. And what is its characteristic as compared wit the calcium carbonate that the other men decomposed?

A. It does not dissolve in cold acid water with any free dom whatever. On raising the temperature to something ove 60 degrees C., evolution of gas takes place.

Q. 100. And does that evolution of gas take place rap idly, in the manner you have described, as to Froment an Bessel?

A. No, it does not. It is a much slower evolution.

Q. 101. And what kind of a floating material is produce in this Potter or Delprat process?

A. I found that the float is invariably agglomerates or aggregates of mineral with some gas bubbles, which float below the surface of the water. Frequently the water can be seen to be perfectly flat, showing the meniscus, although covered with a layer of particles of mineral, whilst underneath this surface there may be as much as a quarter or even half an inch of floating material. This is an entirely different thing to a froth which sits up on top of the water.

Q. 102. You have used the term "meniscus." What is a meniscus?

A. The bending of a surface of water at the point of contact, where it touches the wall of the containing vessel.

Q. 103. The bending of the surface of the water?

A. Yes; water is usually bent upwards.

Q. 104. And you took the meniscus to indicate that there was free water; is that the idea?

A. Yes, there was nothing sitting on the top of that water. It was all underneath.

Q. 105. The next patent appears to be the British patent No. 26,295 of 1902 to Cattermole.

THE COURT: Was that the sinking process?

MR. WILLIAMS: That is the metal-sinking process. I think we will pass that to the U. S. patent No. 763,259, to Cattermole, of June 21, 1904.

Q. 106. Now, this patent has been described as disclosing a metal-sinking process. What kind of a pulp is used in this process, as disclosed in this patent?

A. An alkaline pulp.

Q. 107. And then we go to 777,273, also to Cattermole, and patented December 13, 1904: what kind of a pulp is disclosed in that patent?

A. An acid pulp.

Q. 108. And that also is a metal-sinking process?

A. Yes.

Q. 109. And what was the utility of the emulsification that is described in those two Cattermole patents?

A. That was to break up the oil into very minute globules, subdivide it, in other words, so that it could be more

evenly distributed on the mineral surfaces.

Q. 110. Now, take the Cattermole, Sulman and Picard patent, No. 777,274. Can you give that patent a descriptive nickname, such as has been given to it?

A. Yes, soap and granulation.

Q. 111. What is the advantage and utility of the use of soap as disclosed in that patent?

A. The soap, on being attacked by the acid, would be converted into fatty acid, which would be distributed in very fine division throughout the pulp, so giving the mineral every chance to become coated with oil.

Q. 112. Now, is the soap soluble?

A. Oh, yes, soap is soluble.

Q. 113. And the fatty acid that is liberated, how is that?

A. That is insoluble. These fatty acids or resin acids refer to the fatty acids derived from fats and resins, such as oleic acid, abietic acid and pimaric acid.

Q. 114. And when this soap is decomposed and the fatty or resin acid is formed, what happens?

A. The fatty or resin acid coats the mineral.

Q. 115. And then in this process, what follows?

A. Following that there is a thorough agitation of the mixture. The coated metalliferous particles adhere together and form granules.

Q. 116. Which sink?

A. Which sink, yes.

Q. 117. Now, take patent 788,247. What is the nickname of that patent?

A. Soap and bubbles.

Q. 118. How does it resemble the other patent, 777,274?

A. It resembles the other patent up to the operation of the process which follows the coating of the mineral particles. There the difference starts.

Q. 119. And what is the difference?

A. In the previous patent, the coated mineral particles were agitated to form granules. In this patent, the coated mineral particles are removed from the pulp by generating gaseous bubbles in the mixture, the gaseous bubbles attach-

ing themselves to the coated particles and raising them to the surface.

By THE COURT:

Q. 120. Is that a flotation process?

A. Yes, sir; a skin flotation process.

By MR. WILLIAMS:

Q. 121. And are there other methods described of floating the mineral?

A. Yes, there are other methods, such as attaching them to wood, sawdust or other suitable material lighter than water.

Q. 122. Now, as a matter of fact, Mr. Higgins, does or does not the description of that patent tell about all that was known of flotation at that time?

A. Yes, it does.

Q. 123. And the result of the operation of that patent you said was skin flotation?

A. Skin flotation.

By THE COURT:

Q. 124. Skin or skim?

A. S-k-i-n.

By MR. WILLIAMS:

Q. 125. And then there is another term that is used synonymously for it, a little more elegant—film flotation?

A. Film flotation, yes.

Q. 126. Now, in the disclosure or the disclosures of these two patents, Nos. 777,274 and 788,247, page 1, line 40, and we will take 777,274 first, there is a reference to "a fatty or resin acid or other compound, such as cresol," and so forth. Those words are exactly repeated in the other patent. Now, when you use cresol in the manner disclosed in these two patents, in the first place, how do you put it into the water?

A. As the alkaline salt, cresylate—the sodium or potassium cresylate, whichever may be considered best.

Q. 127. Is that freely soluble?

A. Yes.

Q. 128. And then when you get it dissolved through the solution, what is the next thing?

A. The addition of the acid, sulphuric acid.

Q. 129. And what does that do?

A. That breaks up the cresylate into cresol and the alkaline sulphate.

Q. 130. That is, it decomposes it?

A. Yes.

Q. 131. Now, when the cresol is formed under those conditions, what must it do in accordance with that process?

A. It must come out of solution and be there as an oil, so as to coat the metalliferous particles. In other words, it must be in an insoluble condition.

THE COURT: Somewhere before you get through, I wish you would let him give his view as to soluble and insoluble, if he has any, as distinguished from the view of Professor Taggart.

MR. WILLIAMS: Yes, your Honor.

Q. 132. Now, in order to assure that it shall be insoluble, what is necessary as to quantity?

A. There must be enough to dissolve in the pulp and saturate the water, and then an excess over and above that quantity.

Q. 133. And you said that goes on the mineral and gives it an oily coating?

A. Yes.

Q. 134. And according to your understanding, does any part of the cresol that goes into solution coat the mineral?

A. No, it does not.

Q. 135. What happens to it in the process?

A. It stays in solution and is rejected unless means are taken to recover it.

Q. 136. Now, let us turn to the British patent No. 17109 of 1903. It has been testified that this British patent combines the two things that are separately patented in the two United States patents that you have just referred to; that is true in substance, is it not?

A. Yes.

Q. 137. We will call this the "soap" patent. Now, turn-

ing to page 3 of the specification, there is an expression commencing on line 4:

"thus liberating in a state of chemical subdivision the fatty or resin acid or other compound such as cresol," etc.—"in intimate contact with the suspended ore particles."

What does that mean, according to your understanding?

A. That the fatty or resin acid or other substance is liberated and comes out of solution in the finest possible state that it can do. That is, it comes out as molecules to start with.

Q. 138. What does "chemical subdivision" mean to you?

A. Generally it means the division of molecules; but in this case it only means the fatty or resin acid is divided as fine as it possibly could be divided.

Q. 139. And "division of molecules" is, in general language, what?

A. The destruction of the compound.

Q. 140. Is it decomposition?

A. Yes.

Q. 141. So that chemical subdivision generally means chemical decomposition; is that right?

A. Yes.

Q. 142. But as you read it here, it has the meaning that you have given to it?

A. Yes.

Q. 143. Do you agree with the meaning that Professor Taggart gives to it in his testimony?

A. No, I do not; because when this operation is carried out in the absence of ore, so that one can see what is going on, immediately on adding the sulphuric acid to the soap solution, the liquid turns white, due to the formation there of the insoluble fatty acids. After standing a little while or shaking up, the very fine particles adhere together and in a few minutes or a few hours, according to the quantity of soap that is there, the fatty acid begins to rise to the surface as an oil.

Q. 144. And does it float on the surface as an oil, if you give it time?

A. Yes, but does not remove the milky appearance of the liquid, due to the extremely fine division of the oil. That milky appearance may remain in that liquid for several hours.

Q. 145. That would be a condition which you would describe as what?

A. As chemical subdivision.

Q. 146. What would be this milky condition of the water? Would that be an emulsion?

A. Yes, that is also an emulsion, although it is by no means a permanent emulsion.

Q. 147. Just what do you mean by an emulsion?

A. A mixture of oil and water in such a state that the oil will not collect together and separate on the surface of the water.

Q. 148. Well, it is characteristic of an emulsion that the oil is very finely subdivided and distributed through the water?

A. Yes.

Q. 149. And your understanding of the meaning is that it will stay subdivided?

A. Yes.

Q. 150. That is the true emulsion?

A. Yes.

Q. 151. But emulsion means very fine subdivision of oil in water, does it not?

A. Yes.

Q. 152. Has this soap process proved of any practical value?

A. No, it has not.

Q. 153. Now, we will turn to Patent No. 793,808, to Sulman & Picard.

Mr. Williams: It happens to be Defendant's Exhibit No. 40, your Honor.

Q. 154. You are familiar with that patent?

A. Yes, I am.

Q. 155. What kind of a flotation process, in the most general terms, is disclosed by that patent?

A. A skin flotation process.

Q. 156. Have you carried out the process disclosed in this patent, in the apparatus shown in Figure 1 of the drawings?

A. Yes, I have.

Q. 157. Was that in connection with a litigation?

A. Yes, it was.

Q. 158. And in what case, please, or cases?

A. The Miami case, and a similar kind of apparatus in the Hyde case.

Q. 159. And when you carried this out, what flowed into the launder B4 at the end of the apparatus?

A. Water, carrying on the surface particles of floating oil-coated metalliferous particles.

Q. 160. Are the processes disclosed in that patent of any practical value?

A. No, they are not.

Q. 161. Have they ever been put into practice?

A. No, they have not.

Q. 162. We will take next the patent No. 835,479, to Sulman, Picard & Ballot, of November 6, 1906. That is known as the "boiling" patent, is it not?

A. 835,479?

Q. 163. Yes. No, I am mixed on the patent.

A. No, that is the plus-pressure.

Q. 164. We will turn first to the boiling patent. That is No. 835,143, is it not?

A. Yes, 835,143.

Q. 165. Are you familiar with that patent?

A. Yes, I am.

Q. 166. Is the process disclosed in that patent of any practical value?

A. No, it is not.

Q. 167. What kind of pulps are recommended in that patent?

A. Either acid pulps, neutral pulps, or alkaline pulps.

Q. 168. Is the mineral floated by the process of that patent?

A. Yes.

Q. 169. In what form?

A. In the form of a froth or a scum.

Q. 170. You say the process is of no practical value. What is the basis of that statement?

A. It has not gone into practical operation. In my opinion, the method of raising the mineral particles by steam generated from the boiling liquids is so much more expensive than the commoner method of drawing air from the atmosphere, either by an agitator or blower, the blower forcing air into the pulp, that it could not possibly compete with them.

Q. 171. We will turn to patent No. 835,120, which was issued November 6, 1906. Are you familiar with that patent, Mr. Higgins?

A. Yes, I am.

Q. 172. Has the process disclosed in that patent proved of practical value?

A. Yes, it has.

Q. 173. In the process disclosed in that patent, reading the disclosure as a description, what is the method employed of introducing air into the pulp? I might limit you to Fig. 1, and the general description?

A. By a method of agitation in which the liquid is stirred up into a vortex, the air being drawn in at the vortex and being beaten or broken up into minute quantities.

Q. 174. And the apparatus by which that is accomplished was known as what?

A. As a Gabbett mixer.

Q. 175. You say the air enters at the vortex?

A. Yes.

Q. 176. Does it flow in swiftly or slowly?

A. Very slowly. The vortex forms fairly quickly, but the tip of the vortex is broken up and thereafter only small quantities of air come down the vortex.

Q. 177. Professor Taggart testified that there was some compression in front of the arms of the Gabbett, the side of

the Gabbett, and a vacuum formed in the rear, and as a result air was liberated from solution in the pulp. What have you to say to that?

A. That the liberation of such air would be an exceedingly minute quantity.

Q. 178. And would it be a substantial or a negligible factor in the operation of the process?

A. Quite negligible. Further, that the air in front of the spider where there is a region of pressure, would not dissolve sufficiently rapidly to be of any practical effect. This state of affairs can easily be seen by baffling the liquid above the agitator, so as to prevent any air from entering the liquid from above, when it will be seen that the air liberated from solution by the action of the vacuum is very minute, in fact inappreciable.

Q. 179. There has been reference to the impeller or propeller form of agitator. Have you carried on experiments with that form of agitator?

A. Yes, I have.

Q. 180. Several thousand times?

A. Yes.

Q. 181. And also with the Gabbett several thousand times?

A. Yes, I am quite sure I have.

Q. 182. When you had the impeller form of agitator which is not shown in the first patent No. 835,120, is there any substantial action of solution by compression or the release of air by vacuum, as the result of the rotation of the impeller?

A. No, there is not; such an experiment as I have described in my previous answer proves that.

Q. 183. What have you to say as to Professor Taggart's experiment, whereby he made a little hole in one of the impellers and measured the vacuum, as he said?

A. I fail to understand how he got the measurements and don't quite appreciate the effect of his experiments. It appears that the vacuum there was very much bigger than it should have been.

Q. 184. Just what did his experiment show?

A. I think it was about one-third of an atmosphere, a

partial vacuum. That is to say, reduction of an atmosphere by one-third, only a partial vacuum, by no means a complete vacuum.

Q. 185. Would it follow from his experiment that if he did not have his hole there, that the vacuum that he measured would be formed?

A. No, I don't think it does.

Q. 186. Now, the particular process described in the specification and illustrated in Fig. 2 of the patent No. 835,120, what is the name given to that specific process?

A. Plus-pressure.

Q. 187. Is a more elegant name superaeration?

A. Yes, superaeration.

Q. 188. Now, what happens in that operation as to the introduction of air into the ore-pulp?

A. This is the method of introducing air by first dissolving the air in the pulp by pressure, and afterwards releasing that pressure so that the air is generated from solution, or liberated, more correctly.

Q. 189. And as it is liberated from solution in the pulp, what does it do?

A. It attaches itself to the oil-coated mineral particles, and carries them to the surface in the form of froth.

Q. 190. Have you carried on that pressure process?

A. Yes, I have.

Q. 191. Have you obtained floating mineral froth by it?

A. Yes, I have. I have obtained satisfactory results by that process.

Q. 192. Is it a practical process of concentrating ores?

A. In my opinion it is not.

Q. 193. Why not?

A. Because the method adopted to introduce the air into the mixture is so much more expensive than that of drawing it from the atmosphere, either by the rotation of an agitator or simply blowing by a pump.

Q. 194. Now, we will go to Patent No. 835,479, and you have told me that that is the Plus-pressure patent?

A. Yes.

Q. 195. Briefly, the subject of that patent is the particular method of Plus-pressure, or superaeration, is that right?

A. Yes.

Adjourned until Tuesday, 3rd July, 1923, at 10 o'clock A. M.

EIGHTH DAY

Bangor, Me.

July 3rd, 1923, 10.00 o'clock A. M.

Trial resumed.

Met pursuant to adjournment.

Parties present as before.

ARTHUR HOWARD HIGGINS resumes the stand.

DIRECT EXAMINATION (Continued)

By MR. WILLIAMS:

Q. 196. Mr. Higgins, in your testimony yesterday afternoon, in answer to Q. 169, and in regard to the so-called boiling patent No. 835,143, by Mr. Sulman, you stated that in the process of this patent the mineral was floated in the form of a froth or scum. Will you please amplify that statement?

A. That answer considers the experiment which I made with that process, and not taking all proportions of oleic acid, which the inventor says may be used, that is less than 5 per cent on the ore. In my opinion, the process would not operate with such a large quantity of oil as 5 per cent. In those experiments which I have made, the quantity of oil was in the region of two pounds per ton of ore.

Q. 197. And what oil was used in your experiments?

A. Oleic acid.

Q. 198. On Saturday in Boston you carried on a demonstration which is described in the record of that day as the First Experiment. You announced beforehand that you would take the concentrate obtained, filter and wash it, and then reagitate it with a fresh charge of water containing sulphuric acid, and form a second froth, but you did not do this

because of the concession of defendant's counsel. This was the experiment with oleic acid. Have you performed this complete experiment as you described it, several times?

A. Yes, I have.

Q. 199. How did the second froth compare with the first froth?

A. The second froth was of the same nature, and contained practically the same amount of mineral.

Q. 200. And where did the frothing agent come from in the second agitation for the purpose of producing that second froth?

A. The frothing agent was there as an oily coating on the surfaces of the metalliferous particles.

Q. 201. Again as to your demonstrations on Saturday, the first and the second, the one with oleic acid and the other with phenol, you did not definitely say on the record whether or not the machines were substantially identical machines. What is the fact?

A. They were substantially identical. As near as it is possible to make two machines the same, they were made the same.

Q. 202. As to your second experiment or test with phenol, here also you did not complete what you had announced you had planned to do, because of a concession of defendant's counsel. Have you made other tests of the same general character with soluble mineral-frothing agents?

A. Yes, I have.

Q. 203. And what has been the result in these experiments of the second agitation?

A. The concentrates, instead of floating to the surface in the form of a froth, are practically wholly sunk in the liquid, only a minute quantity of mineral coming to the surface.

Q. 204. What do these experiments demonstrate to you or show you?

A. They show me that in the first experiment, the mineral-frothing agent coats the metalliferous particles and that

in the second experiment the mineral-frothing agent does not coat the mineral particles.

Q. 205. And referring now to the class of experiments of the same general character as the second, with soluble mineral-frothing agents, you say that these soluble frothing agents do not coat the mineral particles. What happens to the soluble mineral-frothing agents?

A. They stay in solution.

Q. 206. With what soluble mineral-frothing agents have you tried this series of experiments?

A. Phenol, cresol, amyl acetate, terpineol, the soluble constituents of some pine oils, and alpha-naphthylamin.

Q. 207. Just what is terpineol, or possibly, where does it occur in soluble frothing agents?

A. In steam-distilled pine oils.

Q. 208. With what ores have you made these tests?

A. Broken Hill ore, Miami Copper ore, and the defendant's ore.

Q. 209. And with the soluble mineral-frothing agent alpha-naphthylamin, what ores have you used?

A. The defendant's ore, and the Miami Copper ore.

Q. 210. Considering this class of experiments as a whole, have you anything to add to what you have said by way of description of them, or have they been sufficiently described?

A. I do not think they have been described. The experiment consists in taking the soluble mineral-frothing agent, adding that to an ore-pulp and making a mineral-bearing froth. Thereafter the solution is filtered from the froth and the tailings. In order to obtain sufficient quantity of such used solution, I usually do two tests: I add the two solutions together. Then I take an equal part of that solution to what I took in the first treatment, and without adding any soluble mineral-frothing agent to that, retreat another batch of the same quantity of ore. In every case I find that the ore floats with as much readiness and giving practically the same recovery as in the first treatment.

Q. 211. Have you made any experiments for the purpose of determining whether or not a soluble mineral-frothing

agent behaves in the same way as an insoluble mineral-froth-ing agent in coating the mineral in the air-froth flotation process?

A. Yes, I have. The experiments which were carried on on Saturday morning were experiments of that nature. I have done other experiments with the defendant's ore.

Q. 212. And with what mineral-frothing agents or agent?

A. With phenol and alpha-naphthylamin.

Q. 213. You might at this place give a description of those experiments.

A. The phenol experiment I have already described. In the experiment with the defendant's ore I took a sub-aeration machine, having ground the ore with water and the neces-sary quantity of lime, put the pulp into the sub-aeration ma-chine, and added thereto 0.44 pounds per ton of alpha-naph-thylamin in solution. I removed the concentrates and fil-tered the concentrates and tailings, re-doing this test so as to obtain sufficient quantity of the used solution to continue the experiment. The same quantity of the used solution was then taken with a new charge of the same ore, without adding any alpha-naphthylamin, and the concentrates were removed as a froth, as in the previous case. The assays from the first treatment and the assays from the second treatment showed that the results were substantially the same. In this case I also took some of the solution before use, containing the alpha-naphthylamin, and some of the solution after the sec-ond use, and compared the color given by an acid ferric chloric solution. The color was of a very slightly different tint, but probably due to some metallic salts in the solution after use, but the color showed that substantially the whole of the alpha-naphthylamin was in the solution that had been used twice.

Q. 214. Just to make that clear, these chemical color tests showed what as to the amount of alpha-naphthylamin in solution after use in the water?

A. That it had not materially decreased in quantity. I might add that color tests are only somewhat rough deter-minations.

Q. 215. Now, putting it on the basis of consumption of mineral-frothing agent, let us say, given a practical operation, and the concentrates overflowed, what happens in the case of an insoluble mineral-frothing agent?

A. The insoluble mineral-frothing agent coats the metalliferous particles and is practically completely removed from the pulp liquor. Thereafter it is of no further use in the process, except when the concentrates are retreated for the purpose of raising the grade.

Q. 216. Now, upon the same basis, what happens with the soluble mineral-frothing agents?

A. The soluble mineral-frothing agent stays in the solution or circuit liquor, as we call it, and is collected and used over again, when it proves to be a useful mineral-frothing agent, without adding any further quantity.

Q. 217. For a fresh lot of ore?

A. Yes, sir.

By The Court:

Q. 218. Can that be done indefinitely?

A. No, sir. The action of the air on a substance, particularly, such as alpha-naphthylamin, oxidizes or decomposes the material. That decomposition is especially active in the presence of sunlight. All of these pulp liquors go from the circuit or filtering apparatus down to a pond which is always exposed to the light. This undoubtedly brings about decomposition of a substance, as I say particularly of a substance such as alpha-naphthylamin, and results in substantial loss, so that even though the circuit liquor is returned to the mill, fresh quantities of alpha-naphthylamin have to be added.

The Court: It does not have anything to do with the process?

The Witness: No, sir, not in my opinion.

Q. 219. In the metallurgical art and particularly in the air-froth flotation art, what definitions would you give of soluble and insoluble substances?

A. Although I am aware that, as is generally known to chemists, every substance is capable of being dissolved, given an eternity of time and an ocean of water, the understanding

that I have of solubility is that which I find generally confirmed by statements in chemical textbooks. I have found no occasion to alter this understanding with regard to the air-froth flotation art. Where I have had any doubts as to the solubility of a substance, or if the solubility of the substance were not mentioned in a reputable chemical textbook, I should proceed with tests such as I have already described, with the actual operation of the substance on a crushed ore of some kind.

Q. 220. Is oleic acid soluble or insoluble?

A. Oleic acid is insoluble.

Q. 221. Is kerosene oil soluble or insoluble?

A. Insoluble.

Q. 222. I will read to you the substances which appear in an article in the Engineering and Mining Journal, of May 11, 1907, describing the "Vacuum-Flotation Process for Concentration," by Alexander Stanley Elmore, and I wish you to tell me as to the substances named there whether they are soluble or insoluble. The first substance is Californian crude oil.

A. Insoluble.

Q. 222-a. Texas crude oil?

A. Insoluble.

Q. 223. Texas residuum?

A. Insoluble.

Q. 224. Fuel oil?

A. Insoluble.

Q. 225. Russian crude?

A. Insoluble.

Q. 226. Borneo?

A. Insoluble.

Q. 227. Sumatra and similar cheap oils?

A. Insoluble.

Q. 228. Olive oil residues?

A. I do not know the nature of olive oil residues.

Q. 229. How above olive oil itself?

A. Olive oil itself is insoluble.

Q. 230. Would you expect the residues from an insoluble substance to be insoluble?

A. Not always, but in this case I think the residues would be insoluble.

Q. 231. Oleic acid?

A. Insoluble.

Q. 232. Kerosene?

A. Insoluble.

Q. 233. A variety of light oils and fish oils?

A. In my opinion the variety of light oils would be insolubles, insoluble in water. The fish oils I know are also insoluble in water.

Q. 234. Of course, I have understood, although I may not have clearly expressed it, that we are talking now of solubility and insolubility in water; is that correct?

A. Yes.

Q. 235. Now, there are two other oils that are named there, or at least they are called "Oils and Similar substances." One is tars. What have you to say as to the solubility or insolubility of tars in water?

A. Tars contain some small quantity of soluble constituents. The bulk of the tar, however, is insoluble in water.

Q. 236. Have you read this article?

A. Yes, I have.

Q. 237. I will just read a short portion of it near the beginning:

> "The gases attach themselves to the greased mineral particles and, being largely increased in volume, as the result of the partial vacuum applied, cause the greased particles with their attendant bubbles of air or gas to float to the surface of the liquid."

Now, taking that statement in connection with the oils, what quality would that call for in the oils?

A. That calls for the quality of insolubility.

Q. 238. The name "tars" includes a considerable number of substances?

A. Yes, but only a few classes, such as wood-tar and coal-tar.

Q. 239. And tars, are they oils?

A. Strictly speaking, they are not oils, but they contain oils and might be called oily substances because they contain oils.

Q. 240. Now, the other "oil or similar substances" mentioned, is blast furnace oils. What have you to say as to the solubility or insolubility of blast-furnace oils in water?

A. My understanding of the term "blast-furnace oils" is that it calls for the use of what the distiller calls the dead oils.

By The Court:

Q. 241. What is that?

A. Dead oils.

By Mr. Williams:

Q. 242. And what is the characteristic of these dead oils as to solubility, and solubility in water?

A. They are insoluble in water.

Q. 243. Have you ever seen this Elmore-Vacuum process at work?

A. Yes, I have.

Q. 244. When and where?

A. In 1907, as far as I remember, and at the works of the Ore Concentration Syndicate, Limited, in London.

Q. 245. The proprietors of the process?

A. Yes.

Q. 246. And what was the occasion of your seeing it there?

A. It was in connection with a lawsuit between Minerals Separation, Limited, and the Ore Concentration Syndicate, Limited.

Q. 247. And was this an exhibition by the proprietors of the Elmore process, of their process at work, to the adversary?

A. Yes. I understood at the time that this exhibition was ordered by the Court. Counsel and experts on each side attended.

Q. 248. You were one of the experts for Minerals Sep-

A. Yes, I had charge of the experimental work at that time in connection with these lawsuits.

Q. 249. What kind of an ore was treated, as to the presence or absence of slime?

A. It was a coarse ground ore and practically free from slimes.

Q. 250. Generally, what was the size of the plant? Was it more than a laboratory apparatus?

A. Oh, yes; it was a full-sized unit, capable of treating about fifty tons a day.

Q. 251. What sort of material overflowed from the constricted opening at the top of the machine?

A. Flocks of mineral containing or entangling some air bubbles which were floating beneath the surface of the water, principally. There was some difficulty in getting this material over the lip of the discharge, and occasionally the water would come over without bringing any floating materials. Then the level would rise, so that a big gush of water carried these off.

Q. 252. I show you the "Mining Journal" article which is in evidence, dated May 11, 1907, and entitled "The Vacuum Process for Concentration of Ores." Do the picture and drawing therein fairly represent the apparatus that was exhibited to you and the other experts for Minerals Separation, Limited?

A. Yes, sir.

Q. 253. What oil was used in that demonstration?

A. It was a thick petroleum oil, not so thick as was used in the Elmore Bulk Oil process, but I do not remember the name of it, although it was something of the nature of Texas Fuel Oil.

Q. 254. Soluble or insoluble in water?

A. Insoluble in water.

Q. 255. Now, we proceeded yesterday with a consideration of prior patents. Have you made a summary and classi-

fication of the remaining prior patents, and if so, will you state it?

A. Yes, I have made such a summary and classification. There are two prior patents which are not flotation processes. The Sulman, Picard and Ballot——

THE COURT: Do you want to give the numbers? Would that be of any benefit?

Q. 256. You are giving the numbers?

A. I am giving the numbers, yes. No. 1821 of 1905, and the corresponding Australian specification to Sulman, Picard and Ballot, No. 4655 of 1905. This process is a process of vanning——

By THE COURT:

Q. 256-a. What does that mean?

A. Treatment on shaking tables, such as the Wilfley tables —in which vanning there was added to the water for the purpose of deflocculating the ore particles, an alkali or a substance which lowered surface tension.

Q. 257. And what sort of a process was that generally?

A. A wet or gravity concentration process.

Q. 258. Or water concentration?

A. Yes. There are two patents of the Elmore bulk oil type, one to Schwarz, No. 807,502, a United States patent——

MR. DAVIS: May I interrupt Mr. Higgins a moment? There are two Elmore processes, if your Honor please, one bulk oil and the other vacuum. I do not know that you have that in mind, but I mention it so they will not be confused.

A. (Continuing) In the Schwarz process a particular kind of oil or oil mixture is described for carrying on the same kind of process as the Elmore bulk oil type; and another patent to Kirby, United States Patent No. 809,959, in which a much thinner kind of oil was used in rather smaller proportions to effect a similar process. In this Kirby process, the mineral sank to the interface or the place at which the oil and water met.

Q. 259. And where was the oil in relation to the water?

A. The oil was above the water; floating on top of the

water. There are processes also of the Potter-Delprat type, which consist in flocculating the mineral——

THE COURT: In what?

THE WITNESS: Flocculating it, gathering it all together in flocks or groups and floating it so that it floats principally beneath the surface of the pulp, that is, more or less in the liquid. There is the Sanders United States Patent No. 805,382, and the Elmore patent, British patent, No. 9593 of 1905, which is practically the same operation as the Potter-Delprat process, with the exception that chlorides and hydrochloric acid were used in place of sulphates, nitrates and sulphuric acid or nitric acid.

Q. 260. Can you give some sort of a comparison as to the kind of floating of this float that you speak of, such as would occur on the rivers of Maine?

A. Yes. The comparison would be that in the air-froth flotation process, the froth swims totally on top of the water just as the froth does from the sulphite mills, whereas in the Potter-Delprat processes the float would swim very much more underneath the surface, if not totally so, in a manner that water-logged sawdust would float on water.

Q. 261. Proceed.

A. In the Potter-Delprat classification, I have included the Elmore Vacuum patents, the British Patent No. 17816 of 1904, United States Patent No. 826,411 and the Australian patent 1935 of 1904. This process uses oil, and it is of interest that the United States patent says that soap, alkali or acid may be added to the circuit liquor. The Australian patent includes also the use of an electric current to assist the separation of mineral particles from gangue. There are several patents of the skin flotation type of process in which a sheet of thick pulp is fed to a water surface, so that the mineral particles are launched on the surface of the water in much the same manner that a boat is launched on the water, towards a suitable place for the deposition of the metallic particles, a concentration is effected. These patents are Sulman, Picard & Ballot, United States Patent No. 879,985,

the MacQuisten British Patent, No. 15119 of 1905, and the MacQuisten United States Patent, No. 865,194, and No. 865,195—one is for the process and the other for the apparatus—the MacQuisten Australian No. 4128 of 1905, and the Morgan British Patent No. 10475 of 1905. The MacQuisten United States patents are interesting as disclosing the use of acid, alkali, soluble salt or other substance, to lower the surface tension of the water, and assist in separating the mineral from the gangue.

There are also patents of the air-froth flotation art. The patent to Sulman, Picard and Ballot, British Patent No. 7803 of 1905, which corresponds to the United States Patent No. 835,120, and a somewhat similar process in the patent to Sulman, Australian Patent No. 5738 of 1906. This process resembles the boiling patent referred to yesterday, except that the vapor of an insoluble agent is used in the presence of heat to supply the gas bubbles, the particular agent being in this case carbon di-sulphide. Also the Chapman British Patent No. 8567 of 1907 for the separation of coal, coke or carbon by an air-froth flotation process.

Q. 262. Now, you have called attention to the fact that in several of these patents there is a reference to the use of acid, and in others there is a reference to the use of alkali, and in some a reference to both, and in still others a reference to acid, alkaline and neutral pulps. What generally was the utility of acid or alkali as it developed in these patents of the art?

A. The utility of acid proved to be very marked, and was developed even as late as the patent in suit. The utility of alkali for the same purpose, of assisting the separation of the metalliferous particles from the gangue, although it is clearly stated in many patents of the prior art, was not generally availed of even at the time of the invention of the patent in suit. It had, in other words, no utility at that time.

Q. 263. As to the ores then treated, so far as developed in practice?

A. Yes, I am speaking of practical utility, not scientific utility.

Q. 264. Well, take the operations that were carried on in Australia, so far as you knew of them. You were in Australia, were you not, for a time?

A. Yes, sir.

Q. 265. And about what was that time?

A. The end of 1908 to the early part of 1909.

Q. 266. And what frothing agent was then being used in the froth-flotation process in Australia?

A. Oleic acid.

Q. 267. And with it was there any mineral acid used?

A. Yes, there was used sulphuric acid.

Q. 268. And those operations were practical and commercial operations, for recovering values for the market?

A. Yes, they recovered very considerable values.

Q. 269. And what was the ore?

A. The ore was part of the ore of the Central Mine, Broken Hill—that part which they referred to as the tailings from the lead mill; having taken out what lead they could, the remainder was sent to flotation, where the zinc was separated. They were also treating in another plant a large dump of zinc tailings that had been stored there several years.

Q. 270. Were those the great dumps of Australia?

A. Yes.

Q. 271. And those dumps, they were the reject of what kind of a process?

A. They were the reject of a water concentration process. They contained very valuable quantities of zinc and silver. At that time a good many metallurgists were working with the idea of solving the problem of extracting this zinc from the tailings, which had been found to be quite impossible by the use of the existing methods of water concentration.

Q. 272. Roughly, about how much zinc was in these dumps—very roughly?

A. Between 15 and 18 per cent of zinc.

Q. 273. And how does that amount compare with American zinc ores now being treated?

A. Very favorably.

By The Court:

Q. 274. What do you mean by "favorably"?

A. That it is very much the same as some of the richer zinc ores of America.

By Mr. Williams:

Q. 275. And as to lead, what generally was the composition of these dumps, the residual lead in them?

A. Between 3 and 8 per cent of lead.

Q. 276. In your general résumé you referred to the Kirby patent. Have you studied that patent with any particular care?

A. Yes, I have.

Q. 277. Did you reproduce the apparatus of that patent?

A. Yes.

Q. 278. On what scale and for what use?

A. On laboratory scale, for the purposes of demonstrating the action and results of the process in the suit of Minerals Separation, Limited, against the Miami Copper Company.

Q. 279. And did you operate that apparatus in court?

A. Yes, I did.

Q. 280. And the conclusions that you have stated are the result of all of your study and operation of that apparatus, is that right?

A. Yes, that is right.

Q. 281. Now, how does it happen that with the thin oil that Kirby used, and the amount that Kirby describes, 25 to 75 per cent, the process was not one wherein the mineral particles were entrapped and held in the bulk oil that floated above?

A. The mineral particles were entrapped in the oil, but owing to the thin nature or lack of viscosity of the oil, they fell through the oil as far as they could get; that was the junction of the oil and the water. There they remained for some time, so that separation of some sort was possible. The process did not give, however, practical results.

Q. 282. Returning now to the tests which were made in the presence of the Court on Saturday, I do not think your

evidence very clearly described what you did in the tall sub-aeration machine, before you put the ore in and carried on an operation with the ore. Will you describe that fully now, please?

A. Yes, I filled up the sub-aeration machine with water, having put in extra baffles somewhat near the top, in order to prevent any vortex being formed, down which air could be sent to the impeller, and, having closed the air pipe which supplies air in the normal operation to the bottom of the machine, just underneath the propeller, the agitator was set going, and it was clearly seen that practically no air came out of solution whatever. One or two bubbles did manage to wander down from the surface of the water. This clearly showed me that the vacuum or partial vacuum caused by the action of the impeller was insufficient to liberate any air from solution. The air, once liberated from solution, goes into solution again at a very much reduced speed. It takes considerable time to get air into solution, even though it is under pressure, so that had air been liberated by the action of the propeller, quantities of it should have been seen in the liquid as it was agitated.

Q. 283. Now, in that sub-aeration machine, and in the other one alongside of it that was not so tall, as you testify, you then put in defendant's ore, and alpha-naphthylamin and lime, the same quantity in each machine. What happened to the shorter of the two machines when you started the operation of mixing?

A. The air pipe had become choked. The air refused to enter that machine. On the surface of that pulp there was no mineral-bearing froth. Later we did get the pipe cleared and froth began to form there.

Q. 284. Was that when the Court was present?

A. I cannot be certain about that.

THE COURT: No, when I left the pipe was still stopped.

Q. 285. Now, just what was it that choked that pipe?

A. Well, it was the settling of the ore during that interval when discussion was had as to whether these experiments should be seen by the Court.

Q. 286. And also during that interpolated experiment?

A. Yes, that too.

MR. DAVIS: If your Honor please, I think I should say here that this pipe was also cleared after the rest of us left.

THE COURT: Yes.

Q. 287. So having only one machine to work with, I think your evidence is fairly clear, but just tell us what happened in that one sub-aeration machine?

A. As I increased the air, the depth of froth increased, and as I decreased the air, the depth of froth decreased. This I did two or three times.

Q. 288. And in every instance was the air drawn in or forced in?

A. It was drawn in by the action of the impeller.

Q. 289. Now as to the demonstrations that were given in the glass-sided Callow cells. When we came there, what was being shown in the two glass-sided Callow cells?

A. In one cell there was nothing but the tap water supply being agitated by the air blown in through the canvas bottom. In the other cell, there was roughly the same amount of air blown in, but that contained, in addition to water, alpha-napthylamin in solution and lime in solution.

Q. 290. Now, after some discussion about the dead space, what was done?

MR. DAVIS: Your Honor, it seems to me it is a waste of time to have Mr. Higgins say what your Honor saw, and what we said to one another there.

THE COURT: I do not know about that. My memory may not be so clear on these things after some weeks.

MR. DAVIS: All right.

THE COURT: And it is well to have it on the record, I think.

A. We put a board into the Callow cell containing only the water, and cut off as far as possible, the dead space. The first attempt to cut this dead space off was not quite successful. The board went down as far as the angle irons which held the glass, and was still an inch or an inch and a half from the bottom of the cell.

Q. 291. And that provided a vertical opening at the bottom of the board?

A. Yes.

Q. 292. What was the effect of that on the agitation in this cell?

A. As far as I could observe, there was no effect at all on the circulatory current, but the eddies appeared to me to be little larger and more pronounced.

Q. 293. Then what did you do next?

A. The board was then chipped out at the corners so that it would fit down on the bottom of the cell, and it was replaced on the canvas just at the end, so that a reasonably good fit was obtained. The effect of this was again not to disturb the circulatory current, but merely to enhance the eddies.

Q. 294. Now, how does what was done this time compare with what Mr. Yerxa described in his testimony as to the putting in of a board?

A. As nearly as I can form an opinion from the testimony, we repeated Mr. Yerxa's experiment.

Q. 295. And after this, was the ore run into the cell that contained the lime, X-cake and water?

A. Yes.

Q. 296. And generally, as that operation was carried on, what kind of an operation was it as compared with what you saw in defendant's plant in May?

A. As far as observation went, it was the same operation.

Mr. Davis: Your Honor, I object to that question. The defendant's plant in May is not in issue here. The plaintiffs confine themselves to the last three months in 1919.

The Court: That is technically correct. That objection is technically well taken

Mr. Williams: I think that the defendant has introduced some testimony on the subject of those operations, and that this general comparison is proper for that reason.

The Court: You mean that there has been testi-

mony that it was the same in May as it was in 1919; is that what you mean?

MR. WILLIAMS: I do not know that that has been testified to.

THE COURT: You mean the operation was described as of the operations of May?

MR. WILLIAMS: The operations of May were made the basis of certain determinations which were put in evidence by the defendant, and have thus been introduced into the case by the defendant.

MR. DAVIS: If your Honor please, that is right; I withdraw the objection. We did testify about those speed tests in the tanks.

Q. 297. Now, you have read the stipulation as to defendant's operations in the last three months of 1919, have you not?

A. Yes, I have.

Q. 298. How did those operations in plaintiffs' demonstration plant on Saturday, in the glass-sided Callow cell, compare with those described in that stipulation, having in mind its annexed flow-sheet and reports of operations in the mill, and so forth?

A. In my opinion, the operations at the Boston plant were the same as those described in the stipulation.

THE COURT: Mr. Williams, what have these reports of mill operations got to do with it?

MR. WILLIAMS: They show what recovery was made, what grade of concentrate was obtained. They give the metallurgical facts.

THE COURT: I have not read them over. I thought they were very bulky looking papers.

MR. WILLIAMS: They are the mill reports of tests taken all through the operation, and they show the grade of concentrate.

THE COURT: They show the result of the process?

MR. WILLIAMS: They show how the mill is working and what it does in the way of producing values.

MR. DAVIS: It was not intended to say that we got the same recoveries there in Boston?

MR. GARRISON: No.

THE COURT: No, I did not understand that.

MR. WILLIAMS: But those mill reports are informative to a metallurgist as to the character of the operations.

THE COURT: Yes. I was wondering what bearing they had on the legal proposition.

Q. 299. When you agitate in a Gabbett, as you did in the Court demonstrations of Saturday, and at the completion of the agitation, everything stops, and you see the froth coming to the top, what is happening, or happens, in that froth layer?

A. Immediately after the arrival of the bubbles at the surface—these naturally carry a certain amount of gangue with them, as well as some liquid—the froth begins to drain, some water carrying some gangue falling out of it; one notices that the froth immediately after stopping the agitator appears to be squeezed very slowly. In other words, the bottom of it rises upwardly. In some cases also some mineral drops out as well as some gangue. That was observable in the second experiment on Saturday morning with the phenol. Not very much mineral fell out on that occasion, however, but some mineral seemed to fall from the upper part towards the lower part. Most of this was arrested by bubbles before it fell completely out of the froth.

Q. 300. Is there anything unusual in finding in a froth obtained by soluble frothing agents that some of the mineral falls down with the gangue?

A. No, that is the usual occurrence, especially where the mineral is coarse.

Q. 301. Now, as to the drainage of gangue, what you said applied, as I understand it, to the two experiments, the one with the insoluble and the one with the soluble?

A. Yes sir.

Q. 302. What is the explanation of the fact that gangue is carried up into that froth, when the froth is forming?

A. There are so many bubbles rising at the same time, in such proximity, that they sweep gangue with them, where-

as the mineral particles are attached to the bubbles, and if the bubbles had plenty of room to come up, they would not entangle gangue in that manner.

Q. 303. Now, is or is not that true in pneumatic flotation cells?

A. Yes, the same remarks apply to pneumatic cells.

Q. 304. And how about the speed of the rising bubbles out of the pulp in the pneumatic cells, and the quantity of bubbles?

A. In my opinion the speed of the bubbles coming out of the pulp in the pneumatic cell is greater than the speed of the bubbles coming out of the Gabbett mixer after the agitator is stopped.

Q. 305. How about quantity of bubbles in the pneumatic cell as compared to the Gabbett agitator?

A. The quantity of bubbles is enormously greater than in the Gabbett mixer.

Q. 306. And what happens in the pneumatic cell with this deep froth, and the great quantity of bubbles rising up and rising up more swiftly, as to bringing up the gangue?

A. They bring relatively larger quantities of gangue. Having carried the gangue upward that way, the gangue gradually falls out again in much the same way, or, I should say, exactly the same way as it does in the Gabbett mixer after stopping the agitator, the only difference being the larger quantity of gangue carried up in the pneumatic cell.

By The Court:

Q. 307. Isn't there always some gangue with the minerals in the bubbles?

A. Yes, there is a small quantity always. In some cases it is on the bubble, in some cases it is in the bubble wall, because the bubble is made from muddy water.

Q. 308. It is not by any means pure mineral up there with the bubbles?

A. No sir, not pure mineral.

Q. 309. A very small quantity in proportion of mineral, is there not?

A. Oh, no. At the top of the froth, where the gangue

has had a chance to fall away from the bubbles, and the water to drain away from the bubbles also—at the top the froth is for practical purposes pure mineral, although for scientific purposes you find a good deal of gangue with it.

Q. 310. Now, Mr. Kenyon put some of the dry bubbles on the palm of his hand. With a microscope I could see little bright particles, which I took to be the mineral part, but they were comparatively small in quantity compared with the mass of material which was there. Was the other material outside of the bright particles—was that gangue?

A. No, sir; much of that material that you could not see in the sparkling surface is mineral of so fine a nature that it does not reflect the light.

By Mr. Williams:

Q. 311. Now, when we give these assay figures of copper, for example, that does not represent the mineral, does it?

A. No, it does not.

Q. 312. Suppose we take an example in zinc. Suppose you had a concentrate that was 50 per cent zinc; what would be the amount of mineral in that concentrate?

A. About 75 per cent of zinc.

Q. 313. About 75 per cent mineral?

A. Of mineral, yes, zinc sulphide, I should have said.

Q. 314. That is the combination of zinc and sulphur which is a chemical combination, makes 75 per cent of the concentrate although the amount of zinc present is 50 per cent; is that right?

A. Yes, that is correct, broadly speaking.

Q. 315. Now, taking defendant's ore. There is, according to the assay, a large iron constituent. Is or is not that present in the form of a sulphide or metalliferous mineral?

A. Yes, it is.

Q. 316. And in so far as it is a sulphide or metalliferous metal, is it recovered with the concentrate?

A. Yes, it is, although some may, of course, appear in the tailings.

Q. 317. Now, take the sulphides of copper. Give me a figure of the average concentrates say of the operations

of the last three months of 1919, the grade of copper. Tell me about what that would represent in metalliferous mineral?

A. A grade of about 16 per cent which can be taken as a rough estimate, would mean about 35 per cent of mineral.

Q. 318. So that with 35 per cent of copper mineral and apparently a larger per cent of iron mineral, there would not be a great deal of gangue in the concentrate?

MR. DAVIS: Your Honor, it seems to me that must be very confusing. The iron mineral and everything but the copper mineral has been treated and referred to as gangue. It is gangue after the operation.

THE COURT: It is gangue.

MR. WILLIAMS: No. The iron mineral sulphide is recovered. That is one of the things you can not keep out of your concentrate.

THE COURT: There seems to be a difference of opinion about that.

MR. WILLIAMS: Yes. It is a great problem. The great problem in some mines is due to the great amount of iron sulphide present in the ore.

THE COURT: Well, if that is a problem, leave it to be developed, because I can not tell.

A. I have given an incorrect answer to that amount of gangue in the 16 per cent concentrate.

THE COURT: You may correct it.

A. (Continued) It would be very much less than 65 per cent. It should be in the region of 40 or 35 per cent.

Q. 319. Now, just what figure have you stated now?

A. The amount of the gangue in an average concentrate, for example, 16 per cent copper.

Q. 320. Well, having in mind the copper and the iron mineral, what do you consider to be the gangue in that statement?

A. The rocky constituents, silica and compounds of alumina. The iron present, not as sulphide, but in some other form.

Q. 321. Now, in that concentrate, how much would be

metalliferous mineral, not copper mineral, but metalliferous mineral, roughly?

A. There should be 60 or 65 per cent of mineral present.

Q. 322. And the rest of it would be—

A. The rest of it would be gangue.

Q. 323. Now, what is the fact in air-froth flotation operations, as to the presence of iron pyrites or pyrites in ores, is it largely present?

A. In some ores it is largely present.

THE COURT: Well, which—iron pyrites or other pyrites?

Q. 324. Are not the terms iron pyrites and pyrites practically interchangeable?

A. Yes, one usually understands iron pyrites, when one speaks of pyrite or pyrites.

Q. 325. Now, when iron pyrites, or as it is sometimes called pyrites, is present, where does it go in the froth-flotation operation?

A. It may either go with the froth as a concentrate or with the tailings, dependent on the nature of the ore. In some it goes one way and in some the other.

Q. 326. And where it goes with the concentrate, is it or is it not a dilution of the concentrate?

A. Yes, it is.

Q. 327. Because, as I understand it, iron is not recovered as a metal in this class of operations; is that right?

A. Yes, that is right.

Q. 328. Has it any utility in the concentrate?

A. Yes, it has some utility. In the smelting process it assists in removing some of the gangue stuffs as slag.

Q. 329. And that requires just a definite amount of it, does it not?

A. Yes, a very small quantity of iron is sufficient in any slag.

BY THE COURT:

Q. 330. You must have some iron, have you not, in order to have the smelter work successfully on the other mineral?

A. The usual practice is to get a double silicate in slag, and a little iron makes a slag which is much more fusible. It

does not require such a high temperature to remove the silica.

Q. 331. Don't you ever find copper ores without iron?

A. Practically no, sir. There is one exception. The upper part of a deposit of the Chili Copper Company, that is practically a pure copper sulphate.

Q. 332. That is unusual, is it not?

A. That is unusual, yes.

By Mr. Williams:

Q. 333. How about the porphyries?

A. The porphyries contain iron as well as copper, and the iron appears in the concentrate.

Q. 334. Now, as a matter of fact, does the mill study to produce a concentrate which will be the most acceptable to the smelter?

A. Yes, it does.

Q. 335. Take the case of the zinc ore. Is there a penalty by the smelter for a falling off in the amount of zinc in the concentrate?

A. Yes, usually the smelter will not accept anything less than 40 per cent of zinc.

Q. 336. Do you happen to know what penalty he fixes generally?

A. No, I do not. Those all depend on the smelting contract which is made for the sale of these concentrates.

Q. 337. On the subject of theories, Mr. Higgins, take the theory of adsorption as now put forth in the scientific world, and tell me what kind of adsorption would be present under this theory in a solution of salt in water.

A. A negative adsorption or, in other words, a dilution of the surface layer.

Q. 338. And upon the same theory, what kind of adsorption would be present in a solution of saponin in water?

A. A positive adsorption or concentration in the surface layer.

Q. 339. Now, with salt solution, is it possible to produce a mineral-bearing froth by the air-froth flotation process?

A. Yes, it is.

Q. 340. Are there any limitations to that?

A. It is my experience it only applies to copper ores.

Q. 341. Is it possible to produce a mineral-bearing froth with saponin in solution?

A. No, it is not.

THE COURT: What is that?

MR. WILLIAMS: Saponin is one of the substances named in the patent in suit as an organic substance which will not produce a mineral-bearing froth.

Q. 342. Mr. Higgins, what sort of a substance is saponin?

A. It is a white crystalline solid, which dissolves in water and makes a froth with the water on stirring it or shaking it up, much in the same way that a soap solution makes a froth on water.

THE COURT: What does it come from? What is it made of?

THE WITNESS: It is an organic compound which can be extracted from certain plants, such as the horse chestnut; from the nuts themselves they are able to extract saponin. It occurs also in another plant which is known as soap bark.

By MR. WILLIAMS:

Q. 343. Now, upon the theory of adsorption—

By THE COURT:

Q. 344. Inorganic substances do not produce this froth effect, do they?

A. Yes, salt is one which does.

Q. 345. That is right. Are there many inorganic substances that will do that?

A. No, very few. There is only one that I know of, and that is sulphuric acid; under certain conditions with one particular ore it will give a froth.

Q. 346. In one opinion that I have read, it speaks of your patent, the first two claims. One of them is for a frothing agent and the other an organic frothing agent. It says it makes no difference, because there is no inorganic. That is not correct, is it?

MR. WILLIAMS: It is undoubtedly true as to prac-

tical operations. I know it was not proved in that case that salt would, under certain conditions, act as a mineral-frothing agent, but so far as practical operations go, all the frothing agents that are used are organic.

THE COURT: I see.

MR. DAVIS: I don't agree with that.

THE COURT: You don't?

MR. DAVIS: No, it seems to me that in this case, however, the question is unimportant, because our agent is an organic substance. Your Honor does not have to pass on the difference.

THE COURT: No, but I remember that statement, because there was no inorganic frothing agent, and then this came up. There is a mistake somewhere.

MR. DAVIS: It is certainly true that there are very few inorganic frothing agents, as compared with the large number of organic frothing agents.

By MR. WILLIAMS:

Q. 347. Now, upon the theory of adsorption as now put forth in the scientific world, what kind of adsorption is present as to the organic mineral-frothing agents which we have been discussing, and that you are familiar with?

A. A positive adsorption or concentration in the surface layer.

Q. 348. Just sum that up for me, please, Mr. Higgins. You can do it much better than I can.

A. We have a substance, sodium chloride, common salt, which gives a negative adsorption or dilution of the surface layer, which makes a mineral-bearing froth, but on the other hand we have saponin, which produces a positive adsorption or concentration in the surface layer, which will not produce a mineral-bearing froth, and a number of mineral-frothing agents, as we call them, soluble organic substances which have positive adsorption and will produce mineral-bearing froth.

Q. 349. I am not so sure that you said that saponin was an organic substance; is it?

A. Yes, it is.

Q. 350. Now, Mr. Higgins, as a result of your observations and experiments, can you state whether or not it is possible to attach clean mineral particles to air bubbles in pure water?

A. Yes, I have seen this done many times.

Q. 351. What kind of attachment results?

A. A firm attachment, so firm that the bubble will carry the mineral up to the surface of the water.

Q. 352. And then what happens with pure water, when the bubble carries the mineral up to the surface of the water?

A. The bubble bursts on reaching the surface, drops most of its load, although it may leave on the surface a few particles floating.

Q. 353. Now, when you add to that water a mineral-frothing agent what, in your opinion, is the difference as to the attachment of the air bubble for the mineral particle? Is it changed or unchanged?

A. Yes, it appears to be changed in some direction, so that the actual weight which is lifted is somewhat less, but the attachment of the mineral particle to the bubble takes place much more readily.

Q. 354. And with a soluble mineral-frothing agent, what happens when the bubble gets to the surface?

A. The bubble does not break with anything like so much rapidity.

Q. 355. What quality is imparted to the bubble?

A. The bubble appears to have a stronger wall, more tenacious. The bubbles are very much smaller and, as I said, they are more persistent, and in this case where the bubble breaks in practice, we have other bubbles beneath, which are ready to take up the load dropped by the first bubble, so that the effect is not the same as in the use of one bubble.

Q. 356. Now, will you compare the process of air-froth flotation as carried on with insoluble mineral-frothing agents, with the process of air-froth flotation as carried on with soluble mineral-frothing agents?

A. In the use of the air-froth flotation process with an insoluble mineral-frothing agent, the mineral-frothing agent

coats the metalliferous particles, whereas, in the use of the air-froth flotation process with the soluble mineral-frothing agent, the mineral-frothing agent does not coat the metalliferous particles, but goes into solution. In the case of the soluble mineral-frothing agent, there is a great increase in the number of bubbles which are formed by the same kind of agitation. They are sensibly smaller than in the use of an insoluble mineral-frothing agent. I think those are the major differences.

Q. 357. What is your observation and experience in operations carried on in pneumatic cells? We will take the case of soluble mineral-frothing agents; where do the mineral particles become attached to the air bubble?

A. In the pulp.

Q. 358. In the case of the Gabbett Mixer, or of the agitating machine with the impeller blades, where does the mineral particle become attached to the air bubble?

A. In the same place, that is, in the pulp.

Q. 359. Is there any substantial difference between those two operations?

A. No, there is not.

Q. 360. You have said that you have carried out an operation wherein amyl acetate was the soluble mineral-frothing agent. Have you carried it out with a small percentage of sulphuric acid in solution, say from 0.2 per cent to say 0.5 per cent, and containing in solution a small quantity, say 0.1 per cent of amyl acetate?

A. Yes, I have.

Q. 361. Many times?

A. Yes, many times.

Q. 362. With what ore or ores?

A. With Broken Hill tailings; probably other ores that I do not remember at the moment.

Q. 363. With defendant's process carried on in a pneumatic cell as described in the stipulation, is or is not the process carried on substantially the same as in that example that I have just given you, with amyl acetate?

A. In my opinion, it is.

Q. 364. And does it make any difference that one is carried out in a Gabbett, and the other is carried out in a pneumatic cell, essentially?

A. No, it does not.

Q. 365. Does the alpha-naphthylamin in defendant's process, as carried out in the last three months of 1919, act in substantially the same way as in the example of the Gabbett or other agitating mechanism and the amyl acetate as you have described?

A. Yes, I should say from the experiments I have made, that it acts in the same way.

Q. 366. As the result of your investigations, what have you to say as to whether or not the alpha-naphthylamin in defendant's process becomes mechanically affixed to the metalliferous particles of the ore?

A. It does not. The experiments which I have testified of this morning, convince me that the alpha-naphthylamin does not become so affixed, but remains in solution.

Q. 367. In defendant's process, does the alpha-naphthylamin exert a "preferential affinity for metalliferous matter over gangue?"

A. No, it does not.

Q. 368. Or such a preferential affinity as oil exerts?

A. No, it does not.

THE COURT: You say it exerts no preferential affinity whatever?

THE WITNESS: None whatever, your Honor..

Q. 369. Will you explain what is meant by the "preferential affinity" of oil for mineral, as referred to in this voluminous art of the treatment of minerals with oil?

A. It refers to the fact that the mineral particles may be coated, or will coat themselves with oil in the presence of water.

Q. 370. In preference to what?

A. In the presence of water, in preference to the gangue; and in this way the mineral particle being agitated in water containing oil, will remove that oil completely from the water.

Q. 371. And is the term "preferential" used as dis-

tinguishing what occurs on the gangue particles?

A. Yes, it is. The gangue particles do not show this ready coating with oil in the presence of water.

Q. 372. Now, in the process of air-froth flotation employing soluble frothing-agents, what, in your opinion, does the soluble frothing-agent do in the process?

A. It forms or assists in the formation of a very large number of minute bubbles which attach themselves to the mineral particles.

THE COURT: Is that the purpose of that frothing agent to produce more bubbles?

THE WITNESS: Yes, sir, it produces more bubbles, and bubbles of such nature that they have a greater ease of attachment to the mineral particles.

THE COURT: What is their nature; what is the change in their nature which produces this affinity?

THE WITNESS: I have never found any satisfactory explanation of that, sir.

Q. 373. Now, have you completed your statement; you spoke, for instance, of the attachment of this great number of very small bubbles for mineral particles; where does that take place?

A. In the pulp.

Q. 374. What happens in a froth with soluble mineral-frothing agents? What does it do there, if it does anything?

A. It continues to carry the mineral particle in the froth.

Q. 375. What continues to carry the mineral particle in the froth?

A. The bubble.

Q. 376. What, if anything, does the presence of the soluble mineral-frothing agent do in the froth?

A. Except for the formation of the bubble and the greater ease of attachment to the bubbles of the mineral particle, the soluble mineral frothing agent has nothing further to do with the froth. It does not appear there. It stays behind in the solution.

THE COURT: You mean it is not present in the froth at all?

THE WITNESS: Only to such extent that the froth contains water.

Q. 377. Each bubble is composed of what?

A. A wall of water, in which the mineral particles are fixed or swimming; the water having been made out of the pulp also contains a little gangue because it would be impossible to make a water bubble from muddy water without taking some of the mud into the walls of the bubble.

By THE COURT:

Q. 378. If you could produce more bubbles without using this alpha-naphthylamin, would you get the same results?

A. If you could produce bubbles which would attach themselves with the same ease to the mineral particles.

Q. 379. Outside of that attachment in the presence of this alpha-naphthylamin, what effect it has you do not know?

A. No, I do not know.

Q. 380. You think it has some unknown effect?

A. Yes, undoubtedly.

By MR. WILLIAMS:

Q. 381. In the absence of the soluble mineral-frothing agent in the froth, what would happen to the froth?

A. I do not understand, assuming that the mineral-frothing agent is made to froth and is still in the pulp.

Q. 382. We will assume we are trying to make the froth. What happens in the absence of the soluble mineral-frothing agent?

A. You get large bubbles coming up to the surface and immediately breaking. Strictly speaking, there is not any froth there at all. There may be a collection of two or three bubbles which are rapidly bursting and being replaced by the air, coming out from beneath.

Q. 383. What does the soluble mineral-frothing agent do in the froth if when you have it present the froth persists, and if when it is absent the froth does not persist?

A. It increases the stability of the bubble, and so prolongs the life of the froth.

By THE COURT:

Q. 384. You call this alpha-naphthylamin the mineral-frothing agent?

A. Yes.

Q. 385. You call oleic acid a mineral-frothing agent?

A. Yes.

Q. 386. They do not operate the same?

A. I do not think they do.

By Mr. Williams:

Q. 387. In defendant's process, lime is used? Is lime a strong alkali or weak alkali?

A. Lime is considered a caustic alkali, which means that it is a strong alkali, but it is in no sense as strong as caustic potash or caustic soda.

Q. 388. In the proportions in which it was used in defendant's pulp in the operations during the latter part of 1919, as shown by the stipulation, what would you say as to the alkalinity of that pulp; was it a marked alkalinity or otherwise?

Mr. Davis: Your Honor, I object to that, as irrelevant—

The Court: Will you repeat that?

(Q. 388 repeated as recorded.)

Mr. Davis: The objection is as to the relevancy of it, because the plaintiff admits that our pulp is not acid, which the patent describes. Now, whether it is just outside the patent or a mile outside is immaterial.

By The Court:

Q. 388-a. Is there a marked line of demarcation between acid and alkali?

A. Yes, sir.

The Court: What difference does it make, Mr. Williams, then, if it was considerably alkaline or slightly alkaline? It is on the border-line, it seems.

Mr. Williams: Yes, but can not I approach it by questions?

The Court: Well, approach it, yes; that is another

matter, but if that is the subject of what you are trying to show, whether it is considerably or slightly alkaline, I cannot see the particular relevancy.

MR. WILLIAMS: I am going to show a very important fact.

THE COURT: Something I have not appreciated? If you have something in mind that I do not know about, go ahead.

MR. DAVIS: Is it understood that I have an objection?

THE COURT: Yes.

MR. WILLIAMS: I may say that I do not like to say beforehand what I think the witness will testify to, and, therefore, I wish to develop it by questions.

By MR. WILLIAMS:

Q. 389. Do you remember the question, Mr. Higgins?

A. I think I remember it sufficiently to answer that the alkalinity of the pulp was extremely slight.

Q. 390. And the test that was used for determining that, as has been testified, is or is not that a delicate test?

A. It is a very delicate test.

Q. 391. What is the ordinary metallurgical test for alkalinity?

A. Litmus paper.

Q. 392. In the operations at the Miami mill, you investigated that, did you not—inspected them?

A. Yes, I did.

Q. 393. Prior to the trial?

MR. DAVIS: Your Honor, it is understood that my objection is continuing. I do not see what the operations at the Miami mill have got to do with it.

THE COURT: I do not either, unless he has something in mind.

Q. 394. Prior to the trial of the Miami case?

A. Yes, I did.

Q. 395. How did the alkalinity of the pulp in the Miami operations compare with the alkalinity of the pulp in the defendant's operations?

A. There was also a very slight alkalinity.

Q. 396. Did it show with litmus?

A. No, sir.

Q. 397. And did it show with this very delicate test that the defendant uses?

A. Yes, it did.

MR. WILLIAMS: Your Honor will remember that that was deemed by the Court in that case a neutral pulp, because it was held to infringe a patent, the claims of which were without acid, and the point is that the alkalinity that has been dwelt upon here as creating a difference, is practically the same kind of alkalinity that was before the Court in the other case, and of course in the other case the claims which are here in issue, were in issue, and were held to be infringed.

MR. DAVIS: Now, if your Honor please, I move to strike out all of that testimony.

THE COURT: I do not know about that, Mr. Williams. It was not quite as if that was the Supreme Court of the United States opinion.

MR. WILLIAMS: Of course it does not bind the defendant, and it is not a decision of the Circuit Court of Appeals of this circuit, or the Supreme Court, but I think—

THE COURT: I refer to the authoritative nature.

MR. WILLIAMS: But I think we ought to be able to show in this case what was before the Court in that case.

THE COURT: In the Miami case?

MR. WILLIAMS: Yes, for your information.

THE COURT: I don't know about that.

MR. WILLIAMS: And for your understanding of the decision. Your mind naturally inquires, it seems to me.

THE COURT: It may open up a pretty broad field, it seems to me, if we get at what might be the basis of a decision in another case.

MR. DAVIS: Of course I will have to put in the whole

record, because I don't agree with what Mr. Williams says.

THE COURT: I see your theory, but I don't agree with it. I think we ought to keep this case within the compass of its own sphere, so to speak, and not go into another case already decided on possibly other facts, so I think I will exclude that, Mr. Williams, for that reason.

MR. GARRISON: The Court means it will grant the motion to strike out.

MR. WILLIAMS: Grant the motion to strike out.

THE COURT: Yes, the same thing.

MR. WILLIAMS: Note an exception, if your Honor please.

THE COURT: Yes.

MR. WILLIAMS: Of course that excludes only the testimony as to what happened in Miami.

THE COURT: That is what I am talking about, yes.

MR. DAVIS: If your Honor please, since that was the excuse that Mr. Williams was to offer for bringing in the other thing, I think the testimony ought to be stricken out back to my first objection.

THE COURT: It is really whether the other process was slightly alkaline or considerably alkaline.

MR. DAVIS: Yes, my contention is it makes no possible difference in this case, since it is admitted not to be acid.

THE COURT: I appreciate that fact. At that time Mr. Williams had something in mind that was not apparent.

MR. GARRISON: I think we ought to have the same chance before your Honor that we had in the Third Circuit, to argue that this slight alkalinity is not sufficient to take that outside of the patent.

THE COURT: It is a matter of discretion as to whether that should go in or not as of being of any value to either side. I think I will permit that to stay in, as to whether or not your process is slightly or considerably alkaline.

Q. 398. When you answered his Honor's question as to

whether there was a difference between acidity and alkalinity, what did you have in mind?

A. The chemical distinction between acid and alkali.

MR. WILLIAMS: Direct Examination closed.

CROSS-EXAMINATION.

By MR. DAVIS:

XQ. 399. Mr. Higgins, you said yesterday that of all the substances mentioned as flotation agents in the Bessel patent, none of them was wholly soluble in the proportion specified in the Bessel patent; is that right?

A. Yes, I believe I so testified.

XQ. 402. Were any of those substances partially soluble in the proportions used in the Bessel patent?

A. Yes.

XQ. 403. Were any of those substances wholly soluble in the proportion used in the agitation-froth patent No. 835,120, that is, less than one per cent on the weight of the ore?

A. I have only used one of those, the one which I thought was most soluble, and I found that that was not completely soluble, even when used in quantities less than that quantity given.

XQ. 404. What one was that?

A. The potato fusel oil.

XQ. 405. Is oil of wintergreen an essential oil?

A. Yes.

XQ. 406. And is not oil of wintergreen wholly soluble in those proportions, and did not you so testify in the Miami case?

A. Yes. Oil of wintergreen would be soluble in those proportions, but I did not take oil of wintergreen, because the Bessel patent specifically points out that if the substance is miscible, is partly miscible with water, it must only be partially so, so that it would not be fair to the Bessel invention to take something which was totally soluble in water.

XQ. 407. You think that is true, notwithstanding the

fact that the Bessel patent says, "All the essential oils," and the oil of wintergreen is one of the essential oils?

A. Yes, I think I have put the proper interpretation on that, even though it does say "All essential oils." He could clearly only mean those which are only partially miscible in the proportions stated.

XQ. 408. Yesterday you discussed with Mr. Williams the Froment apparatus which was sent to the laboratory in London; do you recall that?

A. Yes.

XQ. 409. And you pointed out that there was one difference between the substance of the disclosure in the Froment article on the one hand and the substance of the disclosure in the Froment patent on the other hand, that difference being the fact that in the article it was set out that the process did not treat slimes, whereas that fact was not set out in the patent; do you remember that?

A. Yes, sir.

XQ. 410. Was there any other important difference between the disclosure of the article and the disclosure of the patent?

A. The fact that the description specifically mentions mineral engine oil.

XQ. 411. You remember yesterday you emphasized with Mr. Williams the fact that the patent proposed to use twelve per cent of oil?

A. Yes, sir.

XQ. 412. And is it not true that in the article it specifically says that one per cent of oil is to be used with ores containing less than five per cent of mineral?

A. Yes, that is true.

XQ. 413. You did not think that was a difference which would interest the Court in this case?

A. No, it is not a difference which makes any difference in the process as I described it, in my opinion.

XQ. 414. You spoke this morning about some apparatus that you made up, some Elmore apparatus that you tested

in connection with certain litigation in England. Do you remember that?

MR. GARRISON: The witness did not say he tested it.

XQ. 415. You saw, you said, the Elmore Vacuum apparatus in connection with that litigation?

A. Yes, sir.

XQ. 416. That litigation was litigation brought by the Minerals Separation, Limited, against the Elmore Company?

A. I do not remember which suit it was in. There were three or four suits.

XQ. 417. You remember there was a suit brought against the Elmore Company on this Froment British patent?

A. Yes, sir, suit was brought by Minerals Separation against Elmore under the Froment patent.

XQ. 418. That was the British patent that covers the Froment process that you discussed here, and which you say was wholly impracticable?

A. Yes, that was the British patent to Lake, a communication from Froment.

XQ. 419. And that British patent was owned by Minerals Separation, Limited?

A. Yes, so I understand.

XQ. 420. And suit was brought on it against Elmore?

A. Yes.

XQ. 421. Did you take any part in the prosecution of that litigation, as an expert or otherwise?

A. As I say, there were three or four suits going on at about the same time. The experimental work in connection with those suits was not separated.

XQ. 422. That is, you took part in all of the suits, as an expert, is that right?

A. No, I mean to say that the experimental work was done all together.

XQ. 423. And you took part in that experimental work?

A. Yes.

XQ. 424. Professor Taggart's definition of "solubility" was this:

"That an element is soluble if it will to any sensible extent go into solution in water when it is mixed with water in the proportions in which it is used in flotation operations."

And he defined the going into solution as "the disappearance of the substance in the water so that you could not see it." Do you accept that as a proper definition of "solubility" in flotation processes?

A. No, I do not, for the reason that there is no need to take any new quantity of water to get the definition of solubility. For the further reason that if a blue substance, such as copper sulphate, is dissolved in water, one can still see the blue coloring in the water. It does not disappear. It simply spreads itself all over.

XQ. 425. You remember that Professor Taggart took care of that aspect of it by saying that he excluded discoloration, do you not? Do you remember that?

A. I believe he did.

XQ. 426. Do you agree with the definition of "solubility":

"That solubility exists when a mixture of water and the substance to be dissolved in it appear to be one substance and that no definite boundary of either can be seen between the two"?

A. I understand that to mean that the appearance of the substance is uniform to the naked eye. To the naked eye milk is a solution. Therefore, that definition is unacceptable to me.

XQ. 427. In the Miami litigation—and I am referring to page 3570 of the accounting record, did you testify as follows—this is the accounting record, XQ. 341:

"Q. Will you define, as well as you know how, the phrase 'the same use that is always made of the word "soluble"'?' A. The fact that the substance dissolved enters into the water and disappears. The familiar operation of dissolving sugar may be cited, in which the crystals of sugar disappear to all intents and purposes, and become part and parcel of the water."

Did you use that definition in that litigation?

A. Yes, as far as I remember, that is correct.

XQ. 428. Is that a correct definition, according to your views now?

A. Yes, I do not consider that conflicts in any way with the definition I gave this morning.

XQ. 429. Is that a good definition for "solubility" for use in the art of air-froth flotation?

A. No, I do not think it is. I do not think it was given there as a definition of solubility with reference to the air-froth flotation art.

XQ. 430. Do you remember testifying in the Miami accounting proceedings—as appears on page 3571 of the record, in answer to XQ. 356, as follows:

> "The use of the term 'solubility' in connection with air-froth flotation processes, is the more general use of the word 'solubility' which merely implies that a mixture of water and the substance appears to be one substance and that no definite boundary of either can be seen between the two."

Do you remember testifying to that?

A. I do not remember testifying, but I believe I did so testify.

XQ. 431. I show you this page of the record, and ask you to say affirmatively whether that is or is not your testimony (showing record to witness)?

A. Yes. I did not dispute that that was my testimony.

MR. GARRISON: He admitted that it was his testimony. He said he did not remember testifying to that.

THE WITNESS: I do not dispute that I did so testify.

MR. GARRISON: There is no question about that, Mr. Davis.

XQ. 432. I am trying, Mr. Higgins, to get a definition of the word "solubility" with which I can proceed on this cross-examination. May I understand, in the first place, that you accept as a definition the observation of the solution and that if the substance has disappeared, or you cannot see it, you will say that it is in solution; do you accept that here?

A. Yes, provided that the solution is perfectly transparent and it is what we call a brilliant solution or a brilliant liquid, there is no doubt that it has gone into solution.

THE COURT: You are speaking of water always, are you not?

MR. DAVIS: Yes, I am speaking of solution in water.

By MR. DAVIS:

XQ. 433. Do you accept it for that purpose?

A. Yes, I do.

XQ. 434. Now, you will agree, I suppose, that the amount of any definite substance which will go into solution, depends on the amount of water in which you attempt to dissolve it?

A. As I said this morning I am not considering the instance where you have an eternity of time and an infinity of water. That, of course, would make any substance soluble.

XQ. 435. Well, then, you agree with what Professor Taggart said, that solubility is necessarily a relative term, and that to use it with exactness you must specify the amount of the solvent, do you not?

A. No. One can refer to chemical text books and find there that a certain amount of this stuff dissolves in water, in 100 cc., or you will find that it is insoluble, or very slightly soluble, and you will find, in the quantities used in air-froth flotation, no essential difference. It only means to say that instead of taking 100 cc., if such was the usual way of expressing it in a chemical text book—per cent., you take for instance 4000 cc.

XQ. 436. There would be a sensible difference, would there not, whether you dissolve 1 cc. of any substance, in 1000 or 100 cc. of water?

A. No. As Dr. Bacon says, there would be the same amount of oleic acid dissolved, whether you put in one pound or twenty pounds.

XQ. 437. You mean to say, Mr. Higgins, that you can dissolve as much phenol in 1 cc. of water, as you can in a 1000 cc. of water?

A. No, but you get just as much dissolved in 100 cc., whether you put in the limit of solubility, which is about

six per cent, or whether you put in say sixty per cent. The same amount of phenol would dissolve in each case.

XQ. 438. Exactly, because having dissolved all of that phenol that that amount of water would take into solution, you can not dissolve any more in it, that is all that means, is it not?

A. Yes.

XQ. 439. And that is what you mean when you speak of a saturated solution?

THE COURT: If you increase the water you dissolve more of it?

A. Yes, sir.

XQ. 440. Now, taking ordinary temperatures, when you speak of a saturated solution, you mean that that water has taken up all of the substance that it could take up?

A. Yes.

XQ. 441. And then it stops taking up any more of that substance?

A. Yes.

XQ. 442. Now, if you vary the quantity of water that is agitated with the substance, you will take up more of that substance, won't you?

A. Yes.

XQ. 443. Then, is it not true that the extent to which that substance is soluble in water depends upon the amount of water you use to dissolve it in?

A. Yes, it does, I should say that if you are given enough water you can dissolve anything.

XQ. 444. Now, does it not appear necessary to know whether you are using 1 cc. of water or 4000 cc. in ordinary circumstances?

A. No, perhaps I have not expressed myself clearly. For instance, you take oleic acid, and you put in two pounds of oleic acid per ton of ore, for the sake of seeing whether it dissolves or not. You leave out the ore and then you agitate this small quantity of oleic acid with the water, and you will find that practically the whole of that oleic acid is left in the water as an emulsion. You can see it. It is perfectly

evident. But if you increase that amount of oleic acid, you would not get any more oleic acid dissolved.

XQ. 445. Well, because the water would have taken up all of the oleic acid that it was capable of taking up from the smaller amount?

A. Yes.

XQ. 446. In other words, you produce a saturated solution of oleic acid and water?

A. Going away from the definition of solubility to the ultimate limit where you say nothing is insoluble, that is correct.

XQ. 447. Now, Mr. Higgins, I am trying to get away from that extreme definition, and I can not get you to agree upon any amount of water as a proper measure of solubility in the art of flotation. Now, won't you agree with me to use the words solubility in this sense, that a thing is soluble if sensible amounts of it disappear, where you take one cc. of the substance and add to it 4000 cc. of water at normal temperature?

A. May I inquire if the determination as to the sensible quantity disappearing is to be by the naked eye alone?

XQ. 448. Yes. Of course I don't mean by observing what is left, and see if you can see the difference between what is left and what went in.

A. That is what I meant.

THE COURT: You had better ask another question, if he misunderstood it.

MR. DAVIS: Yes, sir, I will.

XQ. 449. Will you agree with me upon this definition of solubility for the use in this cross-examination, that a thing may be said to be soluble in the art of flotation, when there is any sensible quantity of it which, added to 4000 cc. of water at normal temperatures, will go into solution in the sense that it will disappear from sight?

A. I should be willing to accept that, if I could get some understanding of what you mean by a sensible proportion.

XQ. 450. Well, I define a sensible amount as five or six

per cent. That is, that five or six per cent of the substance added will go into solution.

THE COURT: You mean disappear?

MR. DAVIS: Disappear.

THE COURT: Did you give the quantity of the substance?

MR. DAVIS: No, I did not. I should have given the quantity.

XQ. 451. I mean six per cent of one cubic centimeter of the substance, added to 4000 cubic centimeters of the water. Will you accept that definition with that understanding?

A. Yes. I think I could accept such a definition, that the substance would then be considered insoluble.

THE COURT: Insoluble.

THE WITNESS: Insoluble, or more correctly, I think we should call it very slightly soluble.

XQ. 452. You mean using the word solubility in some other sense?

A. No, I think that the expression that I should use in that regard would be very slightly soluble.

XQ. 453. Well, you would say it was soluble up to six per cent, would you not?

A. Yes, sir.

XQ. 454. Now, using that definition of the word soluble—

A. No, I beg pardon, Mr. Davis, that it was six per cent of one gram in 4000. That would not be six per cent solubility.

XQ. 455. What would it be?

A. That would be expressed as soluble to the extent of 0.0015 per cent. I think I am correct in stating that would be generally accepted as being very slightly soluble.

XQ. 456. Well, that solubility would be approximately the same as the solubility of camphor, would it not?

A. I have not determined the solubility of camphor. In my opinion it is much greater than that.

XQ. 457. Well, you will agree, won't you, that camphor is commonly spoken of as a substance which is very slightly soluble?

A. Very slightly or slightly. It is well known that it is soluble in water. From time immemorial camphor water has been used in medicine, that is, water in which camphor is dissolved.

XQ. 458. It is well known that gold is soluble in water, is it not?

A. Yes, that is generally accepted, too.

XQ. 459. It is well known that glass is soluble in water and acids, is it not?

A. Yes, that is also known.

XQ. 460. Do you remember testifying this way in the Miami accounting record? I am quoting from page 4606:

"XQ. 4300. Do you consider the analogy complete between oil and glass, as respects solubility?

"A. Yes, the analogy is quite complete, but the degree of solubility is different."

MR. GARRISON: What is the question, Mr. Davis?

THE COURT: Whether he remembers testifying to that?

A. Yes, I do. That oil was a particular oil, which, in fact, was pine oil.

XQ. 461. Then is pine oil a soluble mineral-frothing agent?

A. Pine oil contains a mixture of a good many substances —chemical substances—several of which are soluble and others insoluble. Both are mineral-frothing agents.

XQ. 462. That is, if you take pine oil in the proportion of less than one per cent on the weight of the ore, and add to it the ore pulp, there will go into solution from that pine oil a substance which is a soluble mineral-frothing agent?

A. Yes, that is correct.

XQ. 463. And such a procedure would be a carrying-out of the process of the patent here in suit?

A. In my opinion it would be the use of the patent in suit, together with the use of the process of patent 835,120.

XQ. 464. That is, you mean that the part of the pine oil that went into solution would act as and constitute the carrying-out of the process of the patent in suit, and the

part of the pine oil which did not go into solution, would act as and constitute the carrying-out of the process of patent 835,120?

A. Yes, simultaneously.

XQ. 465. Now, suppose you take a substance such as phenol, which is wholly soluble in the proportions of less than one per cent on the weight of the ore, and add phenol to the pulp as you did down there in Boston, that would be a practice of the process of the patent in suit, would it not?

A. So I understand, yes.

XQ. 466. Now, suppose you added that phenol in such a quantity that it would not go into solution, that is, put in enough phenol so that some of it remained undissolved, would that be a practice of the process of the patent in suit?

A. Yes, it would still be the operation of the process involving a soluble mineral-frothing agent.

XQ. 467. That is in that case—

A. There would be something else, in addition.

XQ. 468. You would have in that case, according to your idea, the practice of both processes at once, would you not?

A. Provided that the phenol was there in small quantity. I mean the presence of the undissolved phenol was only small in quantity.

XQ. 469. That is any proportion less than one per cent on the weight of the ore undissolved, is that what you mean?

A. Yes.

XQ. 470. Suppose you use pine oil as the flotation agent, and you used one per cent of pine oil on the weight of the ore, would it all remain undissolved, or would some of it go into solution?

A. Some of the pine oil, a very small proportion in that case, would go into solution, the bulk of the pine oil remaining undissolved.

XQ. 471. Do you know what proportion will go in solution?

A. Not exactly. It would be a quantity less than one per cent of the pine oil.

XQ. 472. In my last question I was assuming a case in

which you have present one per cent of pine oil on the weight of the ore. I want to change that to make the figures exact. Take the case where you have one per cent of pine oil on the weight of the ore, the water being present in an amount four times the weight of the ore, so that you have twenty pounds of pine oil and 8000 pounds of water. Will you tell me what percentage of pine oil would be dissolved?

A. I cannot say what percentage exactly would be dissolved, but it would be a small percentage.

XQ. 473. Can you approximate that?

A. Yes, approximately less than one per cent.

XQ. 474. Are you taking into consideration when you say that, any agitation of the ore pulp as in the normal process?

A. Yes.

XQ. 475. Am I correct in understanding that you differentiate there between the part of the pine oil which does not go into solution, and refer to that—you have referred to that, I think, as a "coating oil"—and the part which does go into solution, which you referred to as a "modifying oil"?

I want to get some terms, Mr. Higgins, that you have used to make the cross-examination easier to proceed with, which we can use together. You have used, as I understand it, the words "coating oil" to refer to that proportion of pine oil which does not go into solution, and the term "modifying oil" to refer to that proportion of pine oil which does go into solution. May we use those terms?

A. If it is understood that the two are both mineral-frothing agents. Of course, in this case they are. I do not usually use those words, but I am ready to accept them for this purpose.

XQ. 476. If you were using a mineral-frothing agent of such a character—I take pine oil for an example— and used it in exactly one per cent on the weight of the ore, a fraction of it would go into solution; then you would say that only that part of it which was in solution was a "modifying oil," according to that definition?

A. Accepting your definition, yes.

XQ. 477. And it would be that portion that you say the use of which would constitute a practice of the invention here in issue?

A. Yes.

XQ. 478. And the part which remained undissolved, that is, the part remaining undissolved of this twenty pounds, you would refer to as a "coating oil," is that right?

A. Accepting your definition, yes.

XQ. 479. And it is that part that you say the use of which would constitute a practice of patent No. 835,120?

A. Yes.

XQ. 480. Following that line of reasoning, Mr. Higgins, I suppose you might have an oil or any oily substance like pine oil which was used in more than one per cent on the weight of the ore and yet which, in your opinion, would be a practice of the process of No. 835,120, because some of it had been dissolved; is that not right?

A. Yes, that is correct.

XQ. 481. Using this definition of "solubility" that we have agreed on, am I correct in understanding that you would say that of the substances mentioned in the Bessel patent, some of them are partially soluble and some of them are wholly soluble?

A. The substances used in the Bessel patent as prescribed by Bessel?

XQ. 482. Yes.

THE WITNESS: Will you read me the question, please?

(XQ. 481 repeated as recorded.)

A. Yes. I think if they are referred to that definition, that some of them would be called partially soluble and some of them wholly soluble, and would be rejected in the Bessel process for that reason.

XQ. 483. Now, I did not ask you that. What ones can you name conveniently that would be wholly soluble?

A. If the oil of wintergreen was put in, assuming a pulp of three to one, which is somewhat large, because in boiling this mixture, naturally they take the smallest possible quan-

tity of water they could work with—so if I take three to one, that gives them possibly three times as much water as they need; but with that one gram of oil of wintergreen put in, at twenty degrees C., which is the only solubility figure I find I have with me, only one-fifth of that would dissolve; there would be four-fifths left, which, of course, could be easily seen if it were done without the ore, or the graphite, rather, so that I should say that would cause me to revise the definition of solubility you put to me immediately. Mr. Davis, I believe I misunderstood your question there. Was it in reference to the six per cent of the stuff dissolved in the water?

XQ. 484. I think we do not agree on the six per cent, Mr. Higgins. I am afraid I will have to give that up.

A. I was assuming—

XQ. 485. And I won't pursue it further at this time, anyway. Yesterday, testifying about the Potter and Delprat process, you said—

THE COURT: I think, if that is another matter, we will suspend until the afternoon at two o'clock.

AFTER RECESS

XQ. 486. Mr. Higgins, in the Miami accounting record—I am referring to page 3574—you said "It has always been my opinion that the test of the suitability of an oil or mineral-frothing agent for use in the air-froth flotation process, is the application of the process itself." Are you still of that opinion?

A. Yes, I am.

XQ. 487. And that means that in your opinion, the best way to find out whether an oil or mineral-frothing agent is suitable for use in that process, is to take the agent in the proper proportion and use it in the process?

A. No, I really meant that one should make a small test first, laboratory test.

XQ. 488. Like in those Gabbett mixers that you showed us in Boston?

A. That or any other suitable machine.

XQ. 489. That would be a suitable machine?

A. Yes.

XQ. 490. Can we agree that in making such tests, say, two pounds of the agent per ton of ore would be a fair amount to start out with?

A. Yes, I think so.

XQ. 491. And then if it turned out that this amount was too large, you would keep reducing it until you got the right amount, or if it turned out the amount was too small, you would keep increasing it in subsequent experiments until you got the right amount?

A. Yes, I should if I stayed with that agent. I might change to another agent.

XQ. 492. Yes, but if you stayed with that agent, you would do as I say?

A. Yes.

XQ. 493. And that is in fact doing just what the patent No. 835,120 instructs the man skilled in the art to do, is it not?

MR. GARRISON: If your Honor please, I do not think it is necessary to have the witness say what that patent says. If the patent says so, it says so.

THE COURT: It seems to be well understood.

XQ. 494. Now, please turn to this Haynes British patent No. 488, of 1860. We agree, do we not, that that patent was not a flotation process?

A. No, I was under the impression that Professor Taggart said it was a flotation process.

XQ. 495. I was really asking whether you and I agreed, not whether you and Professor Taggart agreed; but I will put it this way: We agree, at any rate, all of us, that it is not an air-froth flotation process?

A. Yes.

XQ. 496. May I also understand that you agree that it was a process in which it was proposed to take advantage of the so-called affinity of the oils and oily substances there mentioned?

A. Yes, sir.

XQ. 497. Now, Mr. Higgins, let us imagine, if you will, that you are in a mill. You have had practical mill experience with these flotation processes, have you not?

A. Yes.

XQ. 498. Well, let us imagine that you are in a mill, and you have a particular ore which you have not theretofore had occasion to treat with the flotation process, and you are endeavoring to find out what agent is suitable for that treatment, and we will assume, too, that the agents that you have been employing or that you had immediately at hand, have turned out to be unsuitable and that you are looking further for a suitable agent; now, do you think it is fair to say that you would look about in the literature of the flotation art to ascertain what oils and oily substances had been there mentioned as suitable agents?

A. I should probably draw on my knowledge of the art, and I do not think I should have the necessity of referring to the literature, because I remember so much of it.

XQ. 499. And what you would do would be to select from the various oils and oily substances which you remember, or which you might see described in the art, a series of them, or one or more of them, that would seem to you perhaps to be promising; is that right?

A. No, assuming that I had, as you say, some experience with this ore and it refused to yield satisfactory results with certain agents, I should have there a certain amount of information with regard to the way that agent acted with one or two other tests, before I stopped using that agent, and I should be able to satisfy myself what class of agent to apply to that ore.

XQ. 500. You mean by that, you would be able to satisfy yourself what class of the previously known substances which displayed this preferential affinity would be the most promising class to look in; is that the idea?

A. Yes, but I was not particularly referring to preferential affinity.

XQ. 501. We will say, your experience would indicate

to you which one of the classes of oils or oily substances previously known to you from your reading, would offer the best promise of furnishing the desired agent, is that right?

A. Yes, with the correction that that would include not only the oils or oily substances, but also soluble organic compounds.

XQ. 502. Is pine oil an oil or oily substance, in your mind?

A. Referring to the G. N. S. steam-distilled pine oil, which was the one I was referring to this morning, generally speaking, I think I might call that an oil or oily substance, although I have stated that it is from the point of view of the air-froth flotation art a mixture of insoluble and soluble compounds.

XQ. 503. The specification of the patent No. 835,120 instructed the man skilled in the art, did it not, to take less than 1 per cent on the weight of the ore of any oil, fatty acid, or similar substance, having a "preferential affinity for metalliferous matter over gangue," and to add that to his agitator and proceed with his process?

A. Yes.

XQ. 504. Would you think that pine oil is a substance which is an oil or fatty acid or similar substance which has that preferential affinity?

A. Do you want me to answer that question with regard to my knowledge of the state of the art as of the date of the patent, or my present knowledge?

XQ. 505. I want you to answer it having in mind what that language in the patent meant to you the first time you ever read it, which I assume was about the date that the patent specification was written.

A. That term "oil or oily substance" there meant to me at that time the fatty oils and fatty acids derived from those oils, and some petroleum oils.

XQ. 506. You mean to say, Mr. Higgins, that you do not think that the direction of that patent as it was read by the man skilled in the art at the time the patent was written

was a general direction to go to the prior art and select there any one of the oils or fatty acids or other similar substances that had shown a "preferential affinity for metalliferous matter over gangue"?

A. No, the first time I read that specification, that did not occur to me. I should not so have interpreted it.

XQ. 507. You mean to say that if you had an ore in which a fatty acid or a petroleum product would not produce the desired flotation, that your mind would not have been directed to the other known substances which had displayed that preferential affinity, that is, such things as essential oils, tar oils?

A. Yes, I do say so emphatically; but the fact is that we had the ores that would not yield to the treatment that we knew was satisfactory for certain ores, and they were discarded until later inventions made those ores treatable.

XQ. 508. You do not think that the instructions or directions in that patent No. 835,120 were sufficient so that a man skilled in the art would know enough, reading that patent, to try in that process the various oils and oily substances that had been mentioned in the Bessel patent, for instance?

A. No, in my opinion it would not lead him to do that.

XQ. 509. That is, Mr. Higgins, you mean to say that if a man who was trying to float an ore had the patent No. 835,120 in his hand and also had in his hand the Bessel patent, that he would not be instructed by the two to use in that process any and all the substances mentioned in the Bessel patent?

A. No, I do not understand that he would.

XQ. 510. Well, what would be the impediment?

A. The fact that Bessel mentions substances which are not oily substances in any sense—cheese, for instance, and India rubber.

XQ. 511. How about the substances in Bessel that are oily substances; would the instructions be sufficient to enable him to use all the Bessel substances which were oily?

A. I think so, in so far as they were immiscible in water.

XQ. 512. Now, tell me this, Mr. Higgins; do you think that the man skilled in the art, confronted with that situation, and having to decide whether or not to try cheese, for instance, since you select cheese, that he would have said to himself, "Now, it is not an oily substance, and therefore I won't try it." Do you think he would have gone through that process of reasoning, or do you think that he would have tried it to see what happened?

A. I think that depends on the curiosity of the man. For myself, I should certainly not have tried cheese.

XQ. 513. Now, let us suppose that this gentleman, being curious, if you please, went to the Bessel patent, and there read the statement in regard to "all fatty oils and solid fats of the animal and vegetable kingdom, and the fatty acids obtained therefrom," do you think that would justify him in trying all of the fatty acids, or only some of them?

A. That undoubtedly limits him to the fatty acids which are derived from the fatty oils and solid fats. He would not, under those circumstances, take acetic acid, which has been referred to as a fatty acid.

XQ. 514. Why not? Is not acetic acid "a fatty acid derived from an oil of the animal or vegetable kingdom"?

A. No, not in the sense of this statement. Acetic acid does occur in certain fatty oils, but it is not referred to as a fatty oil or fatty acid derived from a fatty oil or solid fat.

XQ. 515. I take it, then, Mr. Higgins, that in making such an investigation as that under discussion, you would place the strictest sort of limitation upon this language, and would not use any substance unless you thought that it was clearly included without question within the language here employed; is that right?

A. No. At that time I should have made one or two tests with the process, picking out one or two substances which I thought suitable, and thereafter discarding it completely as utterly useless.

XQ. 516. Now, do you think that under those circumstances the suggestion of the Bessel patent to use "all es-

sential oils" would justify the man skilled in the art in using all of those oils, or some of them?

A. I do not think it would be any justification for using all those oils. I do not think any man would be justified in attempting to carry out the Bessel process with the essential oil of roses—attar of roses.

XQ. 517. I did not ask you anything about the Bessel process, Mr. Higgins; I asked you whether a man attempting to carry out the process of patent No. 835,120, and referring to the Bessel patent for the list of substances displaying this preferential affinity, would be justified in using all of the essential oils or some of them.

A. I beg your pardon. I misunderstood the question. (Question repeated.) Assuming that "justified" refers to his justification as a metallurgist, I do not think he would. I do not think the essential oils are within the description in patent No. 835,120.

XQ. 518. Don't you think that the essential oils are oils or oily substances having "preferential affinity for metalliferous matter over gangue"?

A. I think so now, yes, that they have certain constituents which have that preferential affinity.

XQ. 519. There was nothing known at the date of that patent, was there, to prohibit or impede a man making such an investigation, to use the oils that Bessel had told him to use?

A. No, but I think a man of experience would not depend too much on the substances mentioned in the prior art, otherwise he would be led into such a network of intricacies, leading nowhere, that he would be wasting time.

XQ. 520. Yes, but, Mr. Higgins, this man, whether he had sense or not, if he used the essential oil of wintergreen and took less than 1 per cent upon the weight of the ore of the essential oil of wintergreen, and put that into his Gabbett mixer, and did exactly what the Patent No. 835,120 told him to do, he would get a mineral-bearing froth, would he not?

A. Yes, I think so.

XQ. 521. That would be a practice of the process of the patent in suit, would it not?

A. No, in my opinion it would be an invention that he had made.

XQ. 522. But it would be a practice of the process of the patent in suit, nevertheless, would it not?

A. Not in my opinion.

XQ. 523. Why not? It would be the use of the organic frothing agent in solution.

A. Yes, but not to coat the metalliferous mineral particles.

XQ. 524. Do you understand the process of the patent in suit requires the coating of the mineral particles?

A. No, the patent in suit does not.

XQ. 525. Now, do you think that a person making such an investigation as I have contemplated and stated, would be justified, upon reading the Bessel patent, in investigating all of the resins of the vegetable and mineral kingdom, their solutions, and the oils obtainable from them by destructive distillation?

A. My answer is as before, that a metallurgist would be justified in taking those which were oily in nature, such as resin oil.

XQ. 526. Well, if he did that, he would find some of them that were very substantially soluble in those proportions, would he not?

A. Yes, but, as I said before, if he dissolves the substance then he does not coat the metalliferous mineral particles, and he does not in my opinion practice the process of the patent No. 835,120.

XQ. 527. I did not ask you that. I asked you whether, if he took less than 1 per cent upon the weight of the ore of one of these resin compounds indicated by this language from Bessel, and proceeded to put it in the Gabbett mixer with the pulp, and carried out the operation as you carried it out in Boston, I say that he would have gotten a mineral-bearing froth, would he not?

A. With some of them, yes.

XQ. 528. And he would have had present a mineral frothing agent in solution, would he not?

A. He could have chosen one that would have given him that condition.

XQ. 529. And if that process were carried out before you now with that particular substance, you would say that it was the practice of the process of the patent here in suit, would you not?

A. No, I do not think so.

XQ. 530. Why not? Have you not already said that if you use a flotation agent of which one constituent or one part is soluble in the ore pulp, that is practicing the invention of the patent here in suit, notwithstanding there is also present undissolved portions of the agent? Has not that been your position?

A. I think I must have misunderstood your previous question. May I have it read? (XQ. 529 and answer repeated as recorded.) I misunderstood your question, Mr. Davis. The answer there should have been "Yes."

XQ. 531. Well, now, to skip to the sixth list of substances in Bessel, which is crude and refined petroleums; there are, as a matter of fact, a great many petroleum products covered by that paragraph which are good mineral-frothing agents, are there not?

A. No, there are not many petroleums which are good mineral-frothing agents. I have only found a few.

XQ. 532. Well, I will put it this way: petroleum products have been used very extensively as flotation agents in this industry, have they not?

A. Yes, but not as mineral-frothing agents.

XQ. 533. That is, you are distinguishing there by the term "mineral-frothing agent" between an agent which merely produces froth, which you now speak of as a mineral-frothing agent, and an agent which brings up the mineral which you call perhaps something else, is that right?

A. I was distinguishing between mineral-frothing agents which will make a mineral-bearing froth, and certain oils which, although they do coat the metalliferous mineral particles, do not make a froth.

XQ. 534. The metallurgical fact is that these petroleum products have been used very widely in mixtures which contain also some other substance like pine oil, which is more distinctly a frothing oil, is that right?

A. Yes.

XQ. 535. Now, to jump to the seventh list of substances in Bessel, tar from brown coal, anthracite coal, wood and peat, and also the oily products of a distillation of these tars, as well as the residues remaining after distillation; now, it is a fact, is it not, that such tars and the oily products resulting from their distillation have been widely used as flotation agents?

A. Yes.

XQ. 536. And an example of such tars is what? Can you give me two or three?

A. The example of the use of crude coal tars.

XQ. 537. And did those tars contain phenol and cresol in substantial quantities, commonly?

A. No; they are not usually in substantial quantities. They are small quantities of the order of 2 or 3 per cent.

XQ. 538. Do the oils derived from those tars by distillation contain substantial quantities of phenol and cresol?

A. The only oil that contains any substantial quantity is the creosote oil or, more generally speaking, the creosote.

XQ. 539. And creosote oils have been commonly used in this art as flotation agents, have they not?

A. Yes, since about 1914.

XQ. 540. And is blast furnace oil one of the oils that are thus derived from coal tar?

A. No; the blast furnace oil is derived from blast furnace tar, which is different in nature to coal tar.

XQ. 541. Would you say the blast furnace oil as a substance is included within the broad description of this paragraph that I have just read you from Bessel?

A. The blast furnace oil?

XQ. 542. Yes.

A. No, I should not include that, because it is tar from bituminous coal, and he has not mentioned bituminous coal.

He has avoided that. He says brown coal and anthracite coal. He does not mention bituminous coal.

XQ. 543. How about Stockholm tar; is that a substance you think of as included within this seventh paragraph?

A. Yes.

XQ. 544. Does that contain substantial quantities of phenol or cresol?

A. I had a note of the exact quantities of phenol and cresol in Stockholm tar, but I do not seem to have brought that with me. As far as I remember, the presence of phenol and cresol is only in exceedingly minute quantity in Stockholm tar.

XQ. 545. Well, will this refresh your recollection—I refer you to page 3773 of the Miami accounting record, where you were asked this question:

> "XQ. 1459. With what coal tar or wood tar products containing cresols or resin acids were you familiar during January, February and March of 1905?
>
> "A. I was sufficiently familiar with light oil and middle oil to recognize them by their smell and viscosities and boiling points and knew that they contained phenol or its homologues. I also knew that Stockholm tar contained a homologue of phenol. I do not understand what is meant by the term 'resin acids'; so that I am unable to answer that part of the question."

A. Yes, as far as I remember, that is correct. The homologue of phenol which is present in Stockholm tar is one of the higher boiling point phenols.

XQ. 546. Mr. Higgins, as I understand it, you agree that when you are using a flotation agent which is insoluble, or which is present in the pulp, undissolved, that agent coats the mineral particles; is that right?

A. No, that is not right. I don't agree with that. You said dissolved in the pulp.

XQ. 547. No, I say undissolved.

A. Yes, I agree if it is undissolved it coats the mineral particles.

XQ. 548. And you agree that the coating in that way,

put upon the mineral particles, aids in the subsequent flotation operation?

A. Yes.

XQ. 549. It helps to attach the air to the particles, is that the idea?

A. Yes.

XQ. 550. Now, if you will turn, Mr. Higgins, to the Cattermole patent No. 777,273, and the Cattermole patent No. 777,274, which are referred to in the specification of the patent No. 835,120, this patent No. 777,273 says for the agent "The 'oil' used may be animal, vegetable, or mineral oil or mixtures of these or such coal or wood tar products or other substances which exercise, like oils, a preferential physical affinity for metallic mineral matter as distinguished from gangue." Do you think that this broad language would justify one attempting to practice the Cattermole process in trying out all of the oils and oily substances mentioned in the Bessel patent?

A. I think he would be justified in trying all of those substances in the Bessel patent which he considered oils, or sufficiently like oils, to preferentially coat the metallic mineral particles.

XQ. 551. The second Cattermole patent, No. 777,274, uses a somewhat more specific statement, as follows:

"Fatty or resin acids," or "certain other aromatic derivatives such as cresols, phenols, etc.," it being understood that those are the substances of which the soaps are to be made. Is that right?

A. Yes.

XQ. 552. And you agree that this patent No. 777,274 instructs a person to use as an agent a soap made of phenol or cresol?

A. Yes.

XQ. 553. I suppose you also agree that the patent No. 788,247 instructs a person to make use of a soap, made of phenol or cresol, as the agent in the flotation process described in that patent?

A. I did not catch the number.

XQ. 554. 788,247, that is the soap flotation patent.

A. Yes.

XQ. 555. Am I correct in understanding, according to your idea, that when those soaps were broken down by the addition of acid to the pulp in Cattermole, the phenols and cresols were released, and then displayed a "preferential affinity for metalliferous matter over gangue"?

A. Yes, when they were there in sufficient quantity to be greater than the solubility of that particular substance in the water.

XQ. 556. Then it is your interpretation of these Cattermole patents that they proposed to have the phenol and cresol present in such quantity that when it was thrown down from the soap it would exist there undissolved?

A. Yes; otherwise one could not get the coating of the metalliferous particles.

XQ. 557. Have you any idea how much phenol and cresol would be dissolved in 4,000 pounds of water at normal temperature?

A. Yes, roughly 240 pounds of phenol, or 120 pounds of cresol.

XQ. 558. And I said 4,000 pounds of water, if you are using the normal flotation mixture containing 8,000 parts of water, it would be about double that, would it?

A. Yes, but there is nothing in this patent which would limit you to four to one pulp. You might use but two to one pulp.

XQ. 559. In other words, in a pulp containing four parts of water you have to have something approximating 500 pounds of phenol to saturate the solution; is that right?

A. Yes, that would be about twice the figure I gave for two parts of water.

XQ. 560. And have you any idea what the price of phenol was at that time, or what it is now, for that matter?

A. No; I did know what the price was of phenol about that time, but I have quite forgotten.

XQ. 561. Do you think that 10 cents a pound would be a good average price for phenol?

A. I am quite sure that it would be more expensive than the process could possibly stand.

XQ. 562. Now, the normal amount of oleic acid used in the Cattermole process was about 2 to 6 per cent on the weight of the ore, was it not?

A. 4 to 6 per cent on the weight of the mineral.

XQ. 563. How much did that amount to on the ton of ore?

A. On Broken Hill ore that came to about 1.8 per cent.

XQ. 564. That is, approximately 20 pounds per ton?

A. No; actually 36 pounds per ton.

XQ. 565. So, as I understand your reading of the patent, it is that one practicing the Cattermole process would use about 36 pounds of oleic acid per ton of ore, but he would use some 536 pounds of this phenol or cresol in the soap?

A. Yes. I might add that both the oleic acid and the phenol were actually too expensive to use on a large scale in practice.

XQ. 566. Now, Mr. Higgins, do you think I fairly state the difference between the Cattermole process and the process of patent No. 835,120 when I say that the process of patent No. 835,120 consisted in reducing the amount of the agent employed by Cattermole?

A. No. It would be an entirely different operation so far as the action went, but it resulted from that reduction. The process resulted——

XQ. 567. I am not trying to get you to speak of what advantages followed from that change; but is it not true that the distinguishing characteristic of the patent No. 835,120, as compared with the Cattermole process, was the reduction in the amount of the flotation agent?

A. Yes, together with the difference in the results, one sinking and the other going to the top as a froth.

XQ. 568. And it was in making that reduction in the Cattermole process that the invention in patent No. 835,120 was discovered; is not that right?

A. Yes.

XQ. 569. And it was the practice after that, under the patent No. 835,120, when using a particular agent, to reduce

the quantity of the agent to a minimum, was it not?

A. Well, as far as the mill man could do it, it was only an operation in one place.

XQ. 570. Yes, but I mean if in the laboratory you were trying out an agent in order to prepare to instruct the mill man, was it not true that for the sake of economy you carried on your experiments until you had reduced the agent to the minimum?

A. No. We were quite satisfied in the laboratory with two pounds to the ton.

XQ. 571. You mean to say that you never tried quantities less than two pounds to a ton?

A. Oh, yes.

XQ. 572. You mean by "Oh, yes," you have tried quantities less?

A. Yes.

XQ. 573. As a matter of fact, this curve that is attached to the Sulman & Picard treatise is carried down to the zero point, is it not?

A. That curve is a purely theoretical curve.

XQ. 574. Well, I will put it this way: do you agree that the attempt for economical reasons was to reduce the agent to the vanishing point or as near that as possible?

A. No, that is always left to the mill man. The question as to whether the agent should be reduced is always to be balanced by the loss in recovery which usually takes place if you reduce it to about the minimum, so that if you find it is worth while sacrificing a few cents worth of agent for the sake of getting ten times as much value in the concentrates, one would not think of going any further than that point, and we have always left those final reductions of the mineral-frothing agent to the mill man.

XQ. 575. Yes, but, Mr. Higgins, in order to ascertain what minimum quantity will give the best results, he has to go, in his experiments, below that minimum, has he not?

A. Yes; he probably goes slightly below.

XQ. 576. If a man familiar with the Cattermole process, and even admitting, if you insist, that the Cattermole process

contemplated the use of 536 pounds of phenol per ton of ore, I say, a man familiar with that process and then reading the first patent No. 835,120, and being instructed thereby to reduce the quantity of the agent to 1 per cent on the weight of the ore, and if so instructed he took 20 pounds of phenol or less to the ton of ore and put it into the Gabbett mixer, and mixed it up as you did in Boston, he would produce a good agitation froth, would he not?

A. He would produce a good mineral-bearing froth, certainly.

XQ. 577. He would be doing the very thing that you did in Boston as illustrating the process of the patent in suit?

A. Yes.

XQ. 578. In other words, according to your view of it, Mr. Higgins, if this mill man was so ignorant that he did not know that Cattermole intended to saturate the solution before proceeding he would never put in the 536 pounds; that is true, is it not?

A. No, that is not true. This mill man, assuming now, of course, he is doing a different process, he is carrying on the Cattermole process, and he knows he has to make granules, he knows those are made by first coating the mineral——

XQ. 579. Let us assume that he does not know that they are made by oil on the mineral, that he is an ignorant man, and the patent tells him to use 4 to 6 per cent on the weight of the mineral, and he takes phenol soap and does that; what would be the result?

A. I do not know what an ignorant man would do to get any kind of result. The patent, as I understand it, is addressed to one skilled in the art, and that requires some knowledge more than even a laborer has.

XQ. 580. Well, now, you said that if he had reduced the quantity to 1 per cent of phenol on the weight of the ore, he would get this agitation froth as you did in Boston, and as I understand it, you say that you agree that in that case the phenol would be present in solution wholly?

A. Yes.

XQ. 581. And you say that in your opinion the phenol would not then coat the mineral, is that right?

A. Yes.

XQ. 582. But you agree that the phenol would in some way affect the situation so that the mineral would rise to the surface in the froth?

A. Yes.

XQ. 583. That is, the mineral would behave just as though it had been coated with phenol, would it not?

A. No, there is a difference that one soon becomes familiar with, especially with regard to the coarser particles.

XQ. 584. Yes, but you say that there would be some effect there that would cause the mineral to rise to the surface in the froth, and you said to his Honor that you did not know what that fact was due to. Is that right?

A. Yes.

XQ. 585. Would you say, Mr. Higgins, that if you used the phenol just up to the point of saturation of the liquid, you would practice the process of the patent in suit, is that right?

A. Yes.

XQ. 586. If you use phenol just beyond the point of saturation, that will be practicing the process of the patent 835,120, because the phenol will then coat the mineral?

A. No, that would be the practice of the two processes together.

XQ. 587. You say it would include the practice of the patent 835,120, because the phenol would then coat the mineral?

A. Yes.

XQ. 588. Would the mineral behave in any different fashion when you passed from 99.9 per cent to 100.1 per cent saturation?

A. Yes, in many cases it does.

XQ. 589. Now, if the solution was saturated at 20 degrees C. and the temperature was elevated to 30 degrees C., and no more phenol was added, the solution would be unsaturated, would it not?

A. Yes.

XQ. 590. So that whether in such a case you were prac-

ticing the process of the patent in suit or the process of 835,120, or both processes simultaneously, would depend upon the external temperature, would it not?

A. Yes.

XQ. 591. The same thing that on a cold day would be practicing the two processes conjointly on a hot day would be practicing only the process of the patent in suit?

A. Yes.

XQ. 592. Well, suppose, Mr. Higgins, that in the process that I have just suggested, instead of using phenol you used some coal tar product which contained soluble and insoluble constituents, so that in the proportions used there would be a constituent which did not go into solution, and one that did go into solution, both constituents being flotation agents, would you say then that you were practicing both the process of patent 835,120 and the process of the patent in suit?

A. Yes.

XQ. 593. Do you know of any flotation agent of which some proportion does not go into solution, when used in practical flotation processes?

A. Yes; oleic acid.

XQ. 594. Any other?

A. None that has been in use on a large scale, but there are one or two petroleum oils which also answer that specification.

XQ. 595. Mr. Higgins, on page 3575 of the Miami accounting record, you said, as I read it, that pine oil was soluble in water, one part in 400 to the extent of 55 per cent. That is, your language was: "One of the larger quantities that I used was 5 cc. of pine oil in 2000 cc. of water. In this last instance the solubility, as far as I remember at the present time, was only about 55 per cent."

A. Yes, sir; the figure there of 55 per cent is not expressed in the same fashion as is commonly used in text books, where the 55 per cent would be solution of water of 100 cc. which contained 55 of pine oil. That refers to 55 per cent of the weight of pine oil which was used in the experiment of dissolving in the water. That is to say, slightly more than one-half of the pine oil dissolved.

XQ. 596. That is, you meant there that if you put 5 cubic centimeters of pine oil into 2000 cubic centimeters of water at ordinary temperature, about 2¾ cubic centimeters of pine oil would disappear in solution?

A. I think that figure referred to 1 gram in 2000, or ½ gram in 2000.

XQ. 597. It is 5 cc. in 2000.

A. Yes, that was 5 cc. in 2000, and the figure you gave would be correct.

XQ. 598. It follows, of course, that if you put 20 pounds of pine oil in 8000 pounds of water, something over 10 pounds of the pine oil will be dissolved, is that right?

A. No. The same figure would hold. You would still get 2.5 or 2.6 pounds, whatever it is, dissolving, and that referring back to the 20 pounds per ton would make the 55 per cent according to the same calculation.

XQ. 599. 2.5 is 55 per cent?

A. 55 per cent.

MR. WILLIAMS: Did you give the same amount of water, Mr. Davis? I did not hear.

MR. DAVIS: It is a mere matter of arithmetic, I take it. I said 20 pounds in 8000.

A. (Continuing.) The figure expressed there would be 11 pounds, 55 per cent, of that pine oil would dissolve, but it would be the same quantity in each case.

XQ. 600. Well, the 55 per cent of 20 pounds, is not the same quantity, is it, as 55 per cent of 5 cubic centimeters?

A. Yes, that would be the same quantity.

XQ. 601. We have got the thing all confused, Mr. Higgins. I will put it to you this way, to get out of it: If from 5 cubic centimeters of pine oil put into 2000 parts of water, 2¾ cc. of pine oil will dissolve, does it follow that of 20 pounds of pine oil put into 8000 pounds of water, something over 10 pounds of pine oil will dissolve?

A. Yes; apparently half of it should dissolve.

XQ. 602. Do you know about how much of it would dissolve?

A. Very much less than that; something in the nature of

about .14 of a pound, something about .14 pounds would dissolve in that amount of water.

XQ. 603. In 8000 pounds of water?

A. Out of the 20 pounds, yes.

XQ. 604. That is an awful big discrepancy, Mr. Higgins; can you explain that to us and tell us what makes you think so?

A. That figure there is given from memory. I looked up the figures I had during lunch time, and the figure that I now give you, .14 pounds, dissolving out of the 20 pounds, is from those figures that I looked up at lunch time. In the Miami record, I spoke from memory, and, not having the notes with me, apparently I was a long way off.

XQ. 605. Can you give me any idea how many pounds of phenol would dissolve in 8000 pounds of water out of 20 pounds added?

A. The whole lot would dissolve.

XQ. 606. And how about the essential oil of wintergreen?

A. Out of the 20 pounds of oil of wintergreen, there should dissolve 5.92 pounds at 20 degrees C. in 8000 pounds of water.

XQ. 607. And I suppose that if 30 pounds of essential oil of wintergreen were used, at least 10 pounds would dissolve?

A. Oh, no. If 30 pounds were used with the 8000 pounds of water, you would still get the same amount dissolved, 5.92 pounds.

XQ. 608. And if 25 pounds were used, you would have about 16 pounds undissolved and the rest in solution; is that right?

A. Out of 20 pounds?

XQ. 609. 25 pounds.

A. 25 pounds. There would be 19.08 pounds undissolved.

XQ. 610. And that would be less than 1 per cent on the weight of the ore, would it not?

A. Yes.

XQ. 611. And you would say that that was the practice of the process of the patent No. 835,120?

A. Yes, as I understand the decision of the Supreme Court.

XQ. 612. In the Miami accounting you said that, "In the practice of the processes of the patents in suit" [and that included the three patents, of course], "it is now almost universal practice to use a mixture of insoluble and soluble frothing agents." Is that a correct expression of the facts?

A. Since that time I think the use of alpha-naphthylamin and xylidine and mixtures of the two has increased, so that is not so strictly true now as it was then.

XQ. 613. But with that exception, the statement is true?

A. Yes.

MR. DAVIS: I may say for your Honor's information that xylidine is another agent developed by the same company that developed X-cake, and I do not imagine it will appear again.

MR. GARRISON: Except on those lists, of course.

XQ. 614. In the Miami record, at page 3783, you gave the following testimony:

"XQ. 1514. In the treatment of the Butte and Superior ore for the purpose of making such determination, if it turned out that oleic acid would not produce satisfactory results, what other agents of the first patent would you suggest trying, in order to note the difference beween the soluble and the insoluble agents?

"A. As an academic exercise, I would suggest that the student should take Lewkowitsch's book on oils, and try each one separately."

Did you so testify?

A. Yes.

XQ. 615. Mr. Higgins, you are well acquainted with Mr. Henry Livingstone Sulman and worked with him in his laboratory in London for a great many years?

A. Yes, I am acquainted with him and have worked with him.

XQ. 616. For how many years?

A. Well, in close association with him, that is, in his laboratory only a few months, but I have known him since the end of 1903.

XQ. 617. You have been associated with him ever since 1903?

A. With slight exceptions, I have not been associated with him since December, 1916.

XQ. 618. This morning you gave us a more or less complete classification under different processes of the patents which you and Professor Taggart discussed. In this Sulman treatise there is a classification. I want to find out whether you agree or disagree with Mr. Sulman. He classifies under "Patents and processes involving the use of oil, grease, tar, or other liquid immiscible with water, with or without the addition of gas flotation," the Haynes patent of 1860; is that right?

A. Haynes does not involve flotation.

XQ. 619. His definition of the class is, "Patents and processes involving the use of oil, grease, tar, or other liquid immiscible with water, with or without the addition of gas flotation."

A. Yes, then Haynes could be classified so.

XQ. 620. And Everson of 1886?

A. Yes.

XQ. 621. And Robson & Crowder of 1894?

A. Yes.

XQ. 622. And Elmore of 1898 and 1901?

A. Yes.

XQ. 623. And Cattermole of 1902 and 1903?

A. Yes.

XQ. 624. Froment of 1902?

A. Yes.

XQ. 625. Sulman, Picard & Ballot of 1903, 1904, 1905?

A. I think those could be included. There is one Sulman, Picard & Ballot I am doubtful about. It does not include any oiling at all.

XQ. 626. And it would include 835,120?

A. Yes.

XQ. 627. Now, Mr. Sulman in summing up the theory of preferential oiling of the mineral particles said, on page 61 of the treatise:

> "Oil and water adhesions to solids are entirely molecular in origin."

Do you agree with that?

A. If he means that the forces which cause the adhesions of the oil to the mineral particle are due to some molecular energy, I think he is probably correct.

XQ. 628. On page 81 of the treatise Mr. Sulman says: "Such methods are utilized in the Sulman & Picard 'Frothing' and 'Plus-pressure' and the Elmore 'Vacuum' processes." Do you understand that he means by Sulman & Picard frothing process, 835,120?

A. Yes, unless the context shows to the contrary.

XQ. 629. I will show it to you in a minute. He says:

> "These processes depend upon the saturation of a liquid with a gas—generally air—and the bringing about of conditions which render the liquid incapable of retaining it in entirety; generation of bubbles on the particles most resistant to wetting by a liquid consequently ensues."

Do you agree with that?

A. I believe it is meant there that frothing is the process of 835,120. I don't agree with these statements.

XQ. 630. That is, you don't agree that in the "Frothing," "Plus-pressure" and Elmore "Vacuum" processes, the processes depend upon the saturation of a liquid with a gas, and the bringing about of conditions which drive the gas out of solution?

A. No, I do not. I think that is more or less correct with regard to the Plus-pressure and the Elmore Vacuum, but I don't agree either with the statement that the gas must come out on the mineral particle. I have seen it come out all through the liquid, especially on the gangue particles.

XQ. 631. Didn't we understand you to say this morning, in effect, that in your opinion the Plus-pressure process was the equivalent of the agitation froth process 835,120?

A. No, I don't remember putting it that way.

XQ. 632-3. They are both described in patent No. 835,120, are they not?

A. Yes.

XQ. 634. On page 93 of the Treatise, Mr. Sulman says, of the Froment method, that "the slightly oiled mineral was found to rise to the surface as a dense scum-like mass." Does that agree with what experience you had with the Froment process?

A. Mr. Sulman is probably describing the same kind of thing that I saw, but I should not call that scum. Even he only calls it "scum-like."

XQ. 635. Do you recall that Mr. Sulman did take part in the operation of this Froment machine that was built or sent over by Mr. Froment to the laboratory?

A. As far as I remember, Mr. Sulman never saw the operation of that machine at the same time that I did. I was referring there to the test tube experiments.

XQ. 636. Now, referring to the Froment method and the Sulman, Picard and Ballot frothing process, at page 94 of the treatise, Mr. Sulman said:

> "Both these processes not only recover finely divided or slime sulphide mineral, but actually demand the presence of the same for the production of a coherent froth."

Does that agree with your experience?

MR. GARRISON: Where is that?

MR. DAVIS: On page 94, next to the last paragraph.

A. No, it does not. The Froment method is not particularized, that is to say, he does not say whether he means the Froment patent or the Froment description, both of which he was familiar with. The Froment description distinctly says that the slimes must be removed.

XQ. 637. But you do not know whether the Froment process as actually practiced recovered the slimes or not?

A. The Froment process was never actually practiced.

XQ. 638. It was practiced in this machine, was it not, even on a laboratory scale?

A. In a laboratory test, yes. In those cases where I did the test, the ore was de-slimed.

XQ. 639. After discussing in this way the Froment method and the Sulman, Picard and Ballot frothing process, Mr. Sulman says:

> "The newer Elmore ('Vacuum') process employs the same general means, but generates the gas by exposing the mixed pulp to a vacuum sufficient to liberate the dissolved air therein contained."

Do you agree with that?

A. I do not understand what he means by "employs the same general means," except that he means the mineral particles are coated with oil.

XQ. 640. Would you not agree with him, if he went further than that, and say that in all three processes the small particles of gas are attached to the oiled mineral particles and lift them to the surface?

A. Strictly speaking, no, because the Elmore process lifts them as far as the surface. They cannot break through the surface and sit on the top like what he calls here the frothing process does.

XQ. 641. But so far as they are lifted, they are lifted by the attachment of air bubbles or particles thereto in the pulp, is that right, in all three processes?

A. Yes, but not by the generation of gas from the air dissolved in the pulp, as he states here.

XQ. 642. In the agitation-froth process, the air is drawn in by the Gabbett mixer and beaten into the pulp, as you explained, is it not?

A. Yes, sir.

XQ. 643. On page 101 of the treatise, Mr. Sulman said:

> "It is quite possible that in the Potter and Delprat flotations gelatinous silica may be present in the scum, and may aid its coherence. But the Sulman-Picard 'Frothing' and the Elmore 'Vacuum' processes produce froths no whit less coherent; and under conditions impossible for the production of gelatinous silica."

Do you think that it is correct to say that the Sulman-Picard "Frothing" and the Elmore "Vacuum" processes produce froths no whit less coherent than the froths produced by Potter and Delprat?

A. Yes, it occurs to me to be a very peculiar way of putting it, but it was well known to him that in the Sulman, Picard and Ballot frothing the result was very much more coherent and very much more persistent than the other two.

XQ. 644. Now, on page 217 of this treatise, referring to the Froment method of the British Patent No. 12778 of June 4, 1902, Mr. Sulman said:

> "A. Froment's method . . . . similarly marks a further great advance upon the hitherto described oil-flotation processes, in that *gas-bubbles* are here, for the first time, relied upon *exclusively.*"

A. I can not find that passage, Mr. Davis.

XQ. 645. Page 217. Have you got it?

A. Yes, thank you.

MR. KENYON: Read it again.

XQ. 646. "A. Froment's method . . . . similarly marks a further great advance upon the hitherto described oil-flotation processes, in that *gas-bubbles* are here, for the first time, relied upon *exclusively* for flotation of the mineral, the oil being used *only* for the purpose of securing the bubble-adhesion (due to the high angular contact factor) exhibited by oil-film-covered substances, or, colloquially, for 'cementing' the bubbles to the mineral. The oil is, of course, employed in quantities quite incapable of floating the mineral by the 'oil-rafting' principle."

Do you agree with that?

A. Yes, generally, except as to his theory which he has put in there.

XQ. 647. That is, you mean except as to the expression due to the high angular contact factor?

A. Yes. Of course, I mean to say that he is correct when he says that there is not sufficient oil there to buoy up the mineral in the bulk-oil fashion.

XQ. 648. And you agree that in Froment the gas bubbles were for the first time used exclusively for flotation of the mineral; the oil being used for the purpose of securing the bubble adhesion?

A. No. The Bessel patents used gas bubbles for the same purpose, for the flotation of graphite, which is a mineral. This is a little broader, that is all.

XQ. 649. That is, you think Mr. Sulman should have attributed to Bessel perhaps the virtue that he here attributes to Froment, or the achievement—I will not say the virtue?

A. If there is any virtue in the achievement—yes.

XQ. 650. Do you agree with Mr. Sulman when he says on page 218:

> "Froment's process is thus of very great importance as first introducing the principles of:
>
> "(a) The use of an amount of oil for mineral flotation quite incapable of floating the mineral by oil-buoyancy alone.
>
> "(b) Securing the adhesion of gas bubbles to submerged sulphide mineral particles by previously coating these with a *thin* film of oil, and thus giving the enhanced gas-adhesion results indicated by the O^1 contact angle and hysteresis values in table D (page 154).
>
> "(c) The principle of generating the gas in the pulp itself—(liberation of any 'nascent' gas), i. e., that of 'supersaturation' of a liquid by a gas, in order to secure gas-adhesion to the surface showing the largest hysteresis range."

Now, do you agree that Froment introduced the principle of using an amount of oil quite incapable of floating mineral by oil-buoyancy alone?

A. No, Bessel did that, if we include graphite as a mineral.

XQ. 651. And Bessel also first introduced the idea of generating gas in the pulp itself?

A. Yes.

XQ. 652. Referring to the Cattermole, Sulman and Picard British patent, No. 17,109, of August 6th, 1903, Mr. Sulman said on page 218:

> "This device" [that is, forming the soap solution] "enables the smallest quantity of oily material to be efficiently applied either for purposes of flotation or granulation."

Do you agree with that?

A. No, I don't agree with that absolutely. I don't consider that that patent did anything efficiently.

XQ. 653. Did anything efficiently?

A. Efficiently.

XQ. 654. Well, do you agree that in that patent this is true, as stated by Mr. Sulman on page 219:

> "The oil is at once precipitated throughout the pulp mass in a condition of almost molecular fineness."

A. Yes. It is the same idea that I explained yesterday in regard to chemical subdivision.

XQ. 655. On page 220 of the treatise, Mr. Sulman takes up a discussion of the Sulman, Picard and Ballot patent No. 7803 of 1905, corresponding to the United States patent No. 835,120, and he describes it as "a further process by the same investors marks an important practical application of the Froment principle." Now, would you say that this patent, No. 835,120, marks an important application of the Bessel principle? I substitute Bessel for Froment, in view of what you have said.

A. No, I should not, unless I was considering very broadly the attachment of gas or air to coated particles.

XQ. 656. Well, you would say that it marked a practical application of a process in which the oil was present, only for the purpose of causing the gas adhesions, and in which gas was relied on to lift the particles to the surface?

A. Yes, but I am considering the Froment patent, when you get so much oil——

XQ. 657. You mean the Bessel patent?

A. Mr. Sulman speaks of Froment. Bessel was slightly different in that respect. Froment has so much oil there that the attachment of the coated particles to the gas bubbles cannot take place. It is simply mechanical entanglement of

the gas in the oil, made viscous by the presence of the sulphide particles which allows the gas to distend the magma.

XQ. 658. As I understand, you agree that Bessel used a quantity of oil wholly insufficient to raft the mineral particles, is that right?

A. Yes.

XQ. 659. And do I understand that you would not agree with what Mr. Sulman says on page 94 of the Froment process, where he says:

> "The minute amount of oil added forms a film-coating on the mineral which to all intents and purposes becomes part and parcel of the particle."

A. No, I don't agree with that reference to the Froment patent. It is more nearly correct in reference to the disclosure of the Froment description, but there the case is altered by the absence of slimes.

XQ. 660. But you would agree to it with respect to the Froment process described in the article, understanding that the mineral present excludes the mineral contained in the slimes?

A. Yes, with the exception that I am a bit in doubt as to what he actually means by part and parcel of the particle.

XQ. 661. Will you look at page 222 of this treatise, which is part of the description of the agitation-froth process. He says:

> "This is the process now in use upon the Central Broken Hill and other mines in the Barrier district."

That means in Australia, does it not?

A. Yes.

XQ. 662. And he continues:

> "and is, with the one exception of the 'Elmore Vacuum' method, the only process which has so far proved capable of saving 'slimes,' as well as 'sharp' mineral sulphide values in such classes of ore."

Do you agree with that?

A. No, I do not.

XQ. 663. Why not?

A. The Elmore Vacnum method does not treat slimes. It was a notable failure in the Barrier district for that very reason.

XQ. 664. It was actually in use in the Barrier district from 1907 to 1910, was it not?

A. Yes, it was. It was in use.

XQ. 665. On a large scale?

A. On a large scale, yes.

XQ. 666. Have you any idea what tonnage?

A. No, they refused to let me see the plant, but I believe they had five units running fifty tons a day.

XQ. 667. About 250 tons a day, so far as you know?

A. Yes.

XQ. 668. Were you ever in the plant?

A. No, I say they refused to let me go in.

XQ. 669. On page 226 of the treatise, Mr. Sulman says of the agitation-froth process and also of the Elmore Vacuum process that

"the main principles of both appear to have been disclosed by Froment."

Do you agree with that?

A. No, I don't agree with that at all.

XQ. 670. Well, in the next sentence he says:

"The converse of the *'Vacuum method'* is the *'Plus-Pressure' method* (superaeration)."

Do you agree with that, that those two methods are the converse of one another?

A. From one point of view, yes, but from the actual results obtained by the two methods in the class of material which they will treat, one is not the converse of the other, except that one will treat material which the other won't.

XQ. 671. Well, in both the Vacuum process and Plus-Pressure process, the air, which attaches itself to the oiled particles and lifts them up in the pulp, is the air which comes out of solution on account of a change in pressure, is it not?

A. Yes.

MR. DAVIS: There seems to be some disagreement on my side as to whether or not it is clearly understood that

there has been no representation made that the recoveries down at Boston were like the recoveries made in the mill. As I understand it, it was stated in evidence that no analysis was made of those recoveries.

THE COURT: I so understood it.

MR. DAVIS: Just clearing up that one question, is all we have.

RE-DIRECT EXAMINATION

By MR. WILLIAMS:

RDQ. 672. Turn to page 101 of the document entitled "The Theory of Concentration Processes Involving Surface Tension," which Mr. Davis calls the Treatise; your attention was called to a sentence commencing on the next to the last line on page 101, and running on the page above. Just to clear up what you have said about it, the three processes referred to in that paragraph are what, as you read it?

A. The processes correspond to Patent No. 835,120, the Elmore Vacuum process, and the Potter-Delprat process.

RDQ. 673. Now, take the next to the last line:

"But the Sulman-Picard Frothing and the Elmore Vacuum processes produce froths no whit less coherent."

Do you agree with the use of the word "froths" as it is used there?

A. It is used here to describe floating material, which I prefer to distinguish by some other name. Two of those floats are classed together and have already been described. The other float is a true froth.

RDQ. 674. And the float which is the true froth is, of course, which one?

A. The one of the Sulman-Picard frothing.

RDQ. 675. Now, Mr. Higgins, this manuscript bound up together and entitled, "The Theory of Concentration Processes Involving Surface Tension" as presented here, how would you designate it? Would you designate it as a treatise on a subject prepared by Sulman & Picard, or how would you designate it?

A. I am familiar with this treatise and have seen it grow more or less from time to time. Mr. Sulman used to discuss many of these things with me, and incidentally tried to force his theories and hypotheses down my throat. I should designate this as a monograph or memoir written with the express purpose of glorifying the hysteresis angle more than anything else.

RDQ. 676. And you said you were familiar with this as it came out from time to time. As a matter of fact was the memoir subjected to change?

A. Yes, it was changed from day to day.

RDQ. 677. As the theories changed?

A. Yes, it was frequently retyped. When the typing became so obliterated by alterations made in pen and ink, it was again re-typed.

RDQ. 678. Assuming this to be the thing that was in existence in the early part of the year 1907, had the changes, alterations and interlineations and re-writing that you speak of, occurred before or after that period or both?

A. Both before and after.

RDQ. 679. Now, returning to page 93 of the treatise, your attention was called to a description which I think was as follows:

> "Froment's method was to mix powdered ore in a vessel with water, to add a small proportion of some readily decomposible carbonate, and to cover the surface with a thin layer of oil quite insufficient of itself to produce the 'oil-buoyancy' effects characteristic of the older type of oil process."

Now, so far as that description has gone, what does it follow the language of?

A. Up to the words "thin layer of oil" that seems to follow the language of the Froment British patent.

RDQ. 680. Well, now will you turn to the Froment British patent and see whether or not you find in it the words "thin layer of oil?"

A. The words in the British patent are "a thin layer of ordinary oil."

RDQ. 681. And what do these words mean to you, first as to "ordinary?"

A. The oil that was then in use in ore-concentration processes.

RDQ. 682. And what was the oil then in use in ore-concentration processes?

A. A thick oil used by Elmore, petroleum oil.

RDQ. 683. And was that the ore-concentration process then in use?

A. Yes.

RDQ. 683-a. Was there any other?

A. No, not at that time.

RDQ. 684. Now, a thin layer in the Froment patent meant a thin layer on what?

A. A thin layer on the surface of the water in the test tube.

RDQ. 685. And that with the ordinary oil meant how much oil?

A. About 12 per cent.

RDQ. 686. In your discussions with Mr. Sulman at and before the production of this particular edition of these notes, was there any appreciation by him of what that language, "thin layer of ordinary oil," meant; if it is not straining your memory too far, Mr. Higgins. If it is, why, do not answer it.

A. No, I do not remember, but his note here seems to show that he did have some appreciation of that quantity.

RDQ. 687. Well, now, we will turn to page 217, which was also called to your attention. The part read to you there was the paragraph commencing, "A. Froment's Method," and it says:

> "*gas-bubbles* are here, for the first time, relied upon *exclusively* for flotation of the mineral, the oil being used *only* for the purpose of securing the bubble-adhesion."

Now, as you understand the Froment process as disclosed in this British patent, how would you characterize the bubble-adhesion that is referred to in Mr. Sulman's notes?

A. That can only mean the entanglement of the bubble

in the viscous mass formed by a mixture of oil and mineral. There is not any actual adhesion there, but that is what he is referring to.

RDQ. 688. What is the effect of an amount of oil greater than that which is employed in the air-froth flotation process, when you are dealing with insoluble frothing agents, if you increase the amount of oil above the amount of oil required for that process; what happens?

A. The next step is the formation of granules as the result of the Cattermole process.

RDQ. 689. And in the formation of granules, is there any substantial adhesion between the air bubbles and the greased mineral particles?

A. No, there is not, especially when the granules are well made; in fact, they can be made perfectly round.

RDQ. 690. Now, as a matter of fact, in the Cattermole process a good deal of air went into the pulp, did it not?

A. Yes.

RDQ. 691. It must have been because you used the same apparatus as in the froth-flotation; is that right?

A. Yes, the same apparatus was used.

RDQ. 692. What happened to that air that went in?

A. It came out again without carrying any mineral particles with it worth mentioning. There were slight losses in that respect.

RDQ. 693. So increase of oil destroys the adhesion of air bubbles for mineral particles; is that right?

A. Yes, it does.

RDQ. 694. Now, again on page 218, in the paragraph (b):

"thus giving the enhanced gas-adhesion results," indicated by certain things related to the hysteresis angle; that being a summary of the advantages of the Froment process. What have you to say as to gas adhesion as used there?

A. That again is a wrong expression to use. It should have been "gas entanglements."

RDQ. 695. And the term "a thin film of oil," with the "thin" underlined, did that have any particular significance?

A. No, unless it was to distinguish a somewhat smaller quantity of oil used in the Froment description from the Froment patent. He may have distinguished it in that respect, a smaller quantity, giving a thinner coating.

RDQ. 696. But as contrasted with the Elmore bulk oil flotation of Froment, would you apply the term "a thin film" to Froment's coating?

A. I think one might apply a thin film in that case, but I should not do so at present.

RDQ. 697. You have testified once or twice about the solubility of wintergreen oil, and I don't know that I have quite understood what you said. For instance, in answer to XQ. 406 just before recess, you said that something was true of oil of wintergreen, and I don't know just what you meant. Will you just read that and tell me what you meant there?

A. Yes, I said that oil of wintergreen would be soluble in proportions of less than 1 per cent, or there would be some proportions, less than 1 per cent of the ore treated, in which oil of wintergreen would be completely soluble in water; that I had not taken oil of wintergreen in operating the Bessel patent, because he pointed out that the substance must be immiscible. It says here miscible. It must be immiscible or only partly miscible with water.

RDQ. 698. Now, you testified in cross-examination that you did some experimental work in England, in connection with the British suits. Were you in any way in charge of the policy as to these litigations?

A. No, I was not.

RDQ. 699. Were you in any way in charge of the technical part as to these litigations?

A. I had charge of the experimental work in connection with these litigations, up to August, 1908.

RDQ. 700. And were you directed in that work by any one, and if so, by whom?

A. Yes, I was directed by counsel, and also by Mr. Sulman and Mr. Greenway.

RDQ. 701. Now, in the air-froth flotation process, what are the normal amounts of pine oil used, when it is used?

A. It is usually employed with some other oil, and the smallest possible quantity is used because of the cost of the agent. A fair general figure would be in quantities of from half a pound per ton to a tenth of a pound per ton.

RDQ. 702. You were asked in regard to a proceeding wherein pine oil was present in the proportion of 20 pounds to the ton. Is that a conceivable operation in the froth-flotation process?

A. No, it is not.

RDQ. 703. The figures that you gave were from one-tenth of a pound per ton up to one-half of a pound per ton, is that right?

A. Yes.

RDQ. 704. When pine oil is used in that normal proportion, about how much of it dissolves?

A. There will dissolve in each case a little more than half the pine oil, the other part, a little less than a half, remaining undissolved in the liquor.

RDQ. 705. Suppose you increased the amount of pine oil up to 20 pounds to the ton without changing the amount of water. Would any more go in solution?

A. Yes, a little more would go into solution, because at the figure one-half pound to the ton there is barely sufficient to saturate the water; so that a little more would go into solution. There would be sufficient there to saturate the water.

RDQ. 706. Can you give me any idea when the point of saturation of those soluble constituents of pine oil would be reached in the total amount of pine oil used, just roughly?

A. It would be somewhere about a half pound per ton.

RDQ. 707. It would be between a half pound and a pound, would it, that the saturation would be reached?

A. Yes, sir; roughly at the half-pound mark.

RDQ. 708. Suppose you now increased the amount of pine oil to 200 pounds with the same amount of water; would any more pine oil be dissolved?

A. No.

RDQ. 709. You were asked on cross-examination about acetic acid. Has acetic acid any popular name?

A. Yes; vinegar.

RDQ. 710. And is it soluble in water?

A. Yes, it is soluble in all proportions.

RDQ. 711. Soluble in all proportions?

A. Yes.

RDQ. 712. And is it a soluble mineral-frothing agent?

A. Yes, it is.

RDQ. 713. Your attention was called to the disclosures in certain Cattermole patents in relation to cresol and phenol. Did you do much work in the laboratory in the days when the Cattermole process was being tested out?

A. No, the Cattermole process, when I got there to the Sulman and Picard laboratory, was in such a state of development that a model plant was being built to send out to a mine for demonstration purposes. After that very little alteration was made of the Cattermole process.

RDQ. 714. For how long a period were you employing the Cattermole process in the laboratory, investigating it?

A. About 15 months, perhaps 16.

RDQ. 715. During those investigations of the Cattermole process, did you or did anyone that you knew of in the laboratory make any use of phenol or cresol in connection with that process?

A. No, they did not. Neither did I, to make the answer complete.

MR. WILLIAMS: That is all, Mr. Higgins.

MR. DAVIS: I have a few questions that I should have asked in cross-examination.

THE COURT: Probably there is no objection.

RE-CROSS-EXAMINATION

By MR. DAVIS:

RXQ. 716. Mr. Higgins, I have in my hand a book entitled, "An Introduction to Theoretical and Applied Colloid Chemistry, 'The World of Neglected Dimensions,' " by Dr. Wolfgang Ostwald, First Edition, 1917, John Wiley & Sons. Is this book of Professor Ostwald's a recognized authority and reference book on the subject of Colloid Chemistry?

A. I do not know that one particularly. I know other books of his that are recognized as authorities.

RXQ. 717. That is, you would say that Dr. Ostwald himself is a recognized authority?

A. Yes.

RXQ. 718. On page 116 of this book he says:

> "In concluding this lecture, let us consider briefly that group of colloid changes in state which are comprised under the heading of *'Adsorption.'* In keeping with what was said at the beginning of this lecture, we may regard adsorption as *that change in concentration which colloids and other dispersed systems suffer at the surfaces where they come in contact with other bodies.*"

Will you accept that as a proper definition of adsorption?

A. No. I am somewhat doubtful as to whether the term "adsorption" should be applied to colloids.

RXQ. 719. This definition of Dr. Ostwald's is "that change in concentration which colloids and other dispersed systems suffer at the surfaces where they come in contact with other bodies." Would you accept the definition if it read: "That change in concentration which dispersed systems suffer"?

A. No, but I would have no hesitation about accepting it if it said "solutions."

RXQ. 720. That is, if the thing read: "that change in concentration which solutions suffer at the surfaces where they come in contact with other bodies"?

A. Yes.

RXQ. 721. And that change in concentration occurs when the solution comes in contact with solids, as well as with other solutions and with gases, does it not?

A. Yes; according to the theory on which that idea has been built. I do not agree with the basis of the whole theory.

RXQ. 722. That is, you do not agree that there is such a thing as adsorption?

A. No, but I do not agree with the deductions which are continually being drawn from Gibbs' mathematical conclusions.

RXQ. 723. Nor does Dr. Ostwald. He says immediately following:

> "This change in concentration is the only constantly observed behavior that is common to all the myriad manifestations generally grouped under the term 'adsorption.'"

Would you agree with that?

A. Yes, I gather that a great many more things are called "adsorptions" than he is willing to admit.

RXQ. 724. And you agree with him in calling adsorption "that change in concentration which occurs in solutions at the surfaces where they come in contact with other bodies?"

A. Yes.

RXQ. 725. Now, he goes on to say:

> "We shall, therefore, consider only this phase of the problem. After such a concentration,"——

and he emphasizes "after"—

> "After such a concentration difference has come to pass, a long series of secondary changes may take place."

And he goes on:

> "In cases of *positive* adsorption there commonly occurs a *fixation* of the colloid or of the dispersed material upon the solid, liquid or gaseous adsorbing surface."

Would you agree that in cases of positive adsorption, there commonly occurs a fixation of the dispersed or dissolved material upon the solid, liquid or gaseous adsorbing surface?

A. If he includes every possible solution in contact with every possible substance—I should object to the word "commonly." If he refers to fabrics, I should agree to it with him.

RXQ. 726. Well, would you agree that in case of positive adsorption there frequently occurs a fixation of the dis-

solved material upon the solid, liquid or gaseous absorbing surface?

A. As far as my experience goes, I could not accept the word frequently.

RXQ. 727. Of course that answer, Mr. Higgins, makes your views on the subject very indefinite. Can you make them more definite?

A. Well, if you leave out the word frequently or always, that would express my views in certain cases.

RXQ. 728. That is, you agree that it does sometimes occur?

A. Yes.

RXQ. 729. And he goes on and says—Dr. Ostwald says:

> "Under such circumstances, the rest of the dispersed system may be poured off without carrying away with it the dispersed material that has collected in the surface."

Do you agree with that, in those cases, where you agree that such fixation does occur?

A. Not entirely, because it would be quite impossible, regarding now the surface in contact as air and liquid—it would be quite impossible to pour off that liquid and leave the surface still sticking to the air.

RXQ. 730. Now, Dr. Ostwald goes on and says, after some further matter:

> "The increase in concentration may go so far that the adsorbed material separates out in solid or even in crystalline form upon the edge of the adsorbent, as observable in the adsorption of organic dyes by charcoal."

Do you agree with that?

A. Yes, I agree with that, because it can happen.

RXQ. 731. Now, I have in my hand another book entitled, "Applied Colloid Chemistry, General Theory, by Wilder D. Bancroft, Professor of Physical Chemistry, Cornell University." Do you know Dr. Bancroft?

A. Yes.

RXQ. 732. Do you think he is an authority on such a subject?

A. I know of no man who talks more and says less on a subject.

RXQ. 733. You don't consider him an authority on the subject?

A. I think he knows a good deal about it, but he does not tell people.

RXQ. 734. In this book of his on page 90, he says:

> "Selective adsorption by a solid from a solution may show itself by relatively more of the dissolved substance being adsorbed than of the solvent, or by relatively less being adsorbed."

Do you agree with that?

A. Yes, that is the generally accepted theory.

RXQ. 735. And he says:

> "Here as in all other cases the adsorption is selective."

Is it generally true that adsorption is selective?

A. No, it should be absorption is selective, but the whole thing being built up on Gibbs' Mathematical Conclusions, there is no reason for any selective adsorption.

RXQ. 736. Dr. Bancroft continues:

> "Hatschek points out that iodides cannot be shown to be present in sea-water by any of the usual tests, and that we owe our supply of iodine to the adsorption of iodides by certain sea-weeds."

Do you agree that certain sea-weeds adsorb iodides from sea water?

A. I don't know. I know that sea-weeds contain iodine, and they are supposed to get it from sea-water. I do not know the process by which they get it; it may not be adsorption.

RXQ. 737. Dr. Bancroft says:

> "According to Skey antimony and arsenic can be removed so completely from solutions of their oxides or chlorides in moderately strong hydrochloric acid (with a little tartaric acid in the case of antimony) by charcoal that neither of them can be detected therein by Reinsch's

tests, although before the treatment they could be detected without difficulty."

Do you agree with that?

A. No, I don't know whether that can be done or not.

RXQ. 738. He says:

"Quite recently Lockemann and Paucke have studied quantitatively the adsorption of arsenic acid by charcoal, hydrous aluminum oxide, hydrous ferric oxide, and albumin. They find that egg albumin and blood serum, when coagulating, carry down certain amounts of arsenic from aqueous solutions."

Are you familiar with those studies?

A. I know that charcoal does remove a good many substances from the water, both solutions and colloidal suspensions, but there has no work been done which will show the nature of the adsorption or the amount of that adsorption, according to Ostwald's definition.

RXQ. 739. On the next page Dr. Bancroft says:

"In 1845 Yorke discussed the adsorption of lead oxide by filter paper, while Muller and Weiske have shown that filter paper takes up such appreciable quantities of barium, strontium and calcium hydroxides that dilute solutions of these salts should not be filtered if they are to be used for quantitative work."

Have you had any such experience with filter paper?

A. No, I cannot say that I have with those dilute solutions, possibly extremely dilute, much more dilute than is generally used.

RXQ. 740. What has the dilution to do with it?

A. In the ordinary work one does, one does not notice the normal amount that is adsorbed, it is so extremely small. When you come down to a very dilute solution, then the adsorption may make an appreciable difference.

RXQ. 741. Dr. Bancroft goes on as follows:

"A special phenomenon in connection with adsorption by filter-paper has been studied by Bayley, Lloyd, Gordon, and others. If a drop of a salt solution be al-

lowed to fall on filter-paper the solution will tend to spread. If the salt is adsorbed very strongly it will not spread and we get a relatively wide water-ring. If the salt is not much adsorbed, it will spread as far as the water. If a strip of filter-paper be dipped into a solution we get a similar phenomenon; the water will rise much farther than the salt if the latter is adsorbed strongly. Gordon found that with a N/40 $CuSO_4$ solution the water rose about 9.2 c.m. in half an hour and the copper salt only 5.5 c.m. With a N/2 solution the copper salt rose 9.2 c.m. and so did the water. Ordinary ink shows the phenomenon well with blotting paper."

Have you observed that phenomenon of the formation of rings on filter-paper and blotting paper?

A. Yes.

RXQ. 742. Do you attribute that to adsorption?

A. No. I have not. It is possible, though, it is due to adsorption.

MR. DAVIS: I have one more question that I would like to ask Mr. Higgins, but it is so involved with the phraseology of what he said in the testimony that I should like to put it off until the next session. If there is no objection. Mr. Higgins will be here when we resume.

THE COURT: I had hoped to finish with him tonight and begin a fresh witness Thursday.

MR. DAVIS: I can do that if we have a moment to do it. I will find out where it is.

RXQ. 743. As I understood you to say this morning, Mr. Higgins, as you understood the expression "blast furnace oil," that meant the dead oils. Was my understanding correct?

A. Yes.

RXQ. 744. I have before me Lunge on "Coal-Tar and Ammonia," Third and Enlarged Edition, London, 1900. Is Dr. Lunge a recognized authority on Coal-Tar and Ammonia?

A. Yes.

RXQ. 745. On page 117 he says:

"In any case, blast-furnace tar is altogether differ-

ent from ordinary gas-retort tar, and cannot be employed for the same purposes."

Do you agree with that?

A. It cannot always be employed for the same purposes, yes.

RXQ. 746. Can both of them be employed for flotation purposes?

A. The tars themselves, I believe so. I do not know as to blast furnace tar.

RXQ. 747. Dr. Lunge goes on:

> "It would require to be redistilled, and would then yield creosoting oils of good quality and lubricating oils of indifferent quality."

Do you agree that blast furnace tar upon redistillation would yield "creosoting oils of good quality and lubricating oils of indifferent quality?"

A. I do not know about the lubricating oils as yielded by the blast furnace tar. I know that it yields creosote oil or creosote, which is useful in creosoting.

RXQ. 748. And you know that it also yields other oils than creosote?

A. Yes, it does.

RXQ. 749. Would you not call both of those oils so yielded upon distillation of blast furnace tar, blast furnace oils?

A. I might.

RXQ. 750. Dr. Lunge continues:

> "Blast furnace creosote is now largely used for pickling timber, for the 'lucigen-light,' and as fuel. The phenols contained therein (25 to 35 per cent against 5 to 10 per cent in gas-tar creosote) resemble those from wood-tar, lignite, or shale-oil."

Do you agree that the phenols contained in these blast furnace creosotes amount to 25 to 35 per cent?

A. Yes. I have had specimens of blast furnace creosote where they go even higher than 25 per cent. I do not say they always do.

MR. DAVIS: That is all.

RE-RE-DIRECT EXAMINATION

By MR. WILLIAMS:

RDQ. 751. You spoke of blast-furnace oils that were dead oils. Did that mean without the tar acids?

A. Yes. Without the tar acids and without the tar bases.

RDQ. 752. And what is the relation of phenols to tar acids?

A. Phenol is the first member of the tar acid series.

RDQ. 753. You said, as I remember it, that in the work one does with solutions, adsorption is not noticed. With extremely dilute solutions it is noticed. What did you have in mind as to the work one does? Did you have in mind what is done in air-froth flotation?

A. No. I meant generally the laboratory work in filtering solutions. You might take a dilute solution, sulphuric acid, for instance, which is roughly 20 per cent sulphuric acid. You could filter that and you could make tests of it, but you would never find there is any difference in the amount of sulphuric acid there by any chemical test. I think I said that you might find that with an extremely dilute solution there would be some difference. You could take perhaps a solution of some substance and filter it, and then, not by a chemical test but by a physical test, such as the alteration of the surface tension, you might find that a minute quantity had disappeared, whereas, if you applied the same physical test to dilute solution such as I mentioned previously, the 20 per cent sulphuric acid, you would not find any alteration in the surface tension.

RDQ. 754. As I remember it, there was a good deal said about charcoal and fibres put in contact with solutions. What fibres are put in contact with solutions, what is the process usually?

A. Dyeing process.

RDQ. 755. And is that the case that you spoke of where the material that was in solution was adsorbed, or is it absorbed by the fabric?

A. In my opinion, both of those processes may occur, or

either of them, with different materials in different solutions.

RDQ. 756. And is charcoal also an absorptive substance? A. Yes, it is.

MR. WILLIAMS: That is all.

THE COURT: You are all through, are you?

MR. DAVIS: May I offer in evidence as Defendant's Exhibit No. 140, this statement of the demonstration here in Bangor and the drawings of the apparatus which have been agreed to?

THE COURT: Yes.

(Received in evidence and marked "Defendant's Exhibit No. 140—Description Defendant's Demonstration at Bangor. Drawings, Laboratory Callow Cell and Laboratory M. S. machine.")

MR. DAVIS: I have a stipulation which has been agreed to by the other side and which has to do with some of those things we asked interrogatories about, and they referred us to the testimony in prior cases.

THE COURT: That may be filed.

MR. DAVIS: We will read it right into the record, if it suits you.

MR. GARRISON: One minute.

THE COURT: I thought it was a stipulation.

MR. GARRISON: I understand. I have not said I signed this yet.

THE COURT: It cannot be a stipulation until it is signed.

MR. DAVIS: I will read all the changes you suggest.

MR. GARRISON: I also want you to agree to those affidavits I gave you.

MR. DAVIS: We will let that go. We will have no trouble, I think, on that.

MR. GARRISON: We will have no trouble on that, but it is a case of tit for tat.

MR. DAVIS: Is there any objection to my covering these specimens with paraffin over the holiday? These liquids might begin to come through the coverings.

THE COURT: It seems quite desirable to do that. Will you be able to finish this week?

MR. GARRISON: Thursday,—I think so.

MR. WILLIAMS: One day more.

THE COURT: One day more?

MR. WILLIAMS: That is my expectation.

THE COURT: That is, for your evidence?

MR. WILLIAMS: Our evidence won't take all day.

THE COURT: What is your plan about the argument?

MR. WILLIAMS: If your Honor please, in a case like this, where so much is just thrown into the record, it seems to us that it would be futile to now attempt an argument, and that we would not economize the time of the Court, and it would not be a proper presentation of the case until the whole case had been studied. It is going to take two or three weeks to print the record, and then comes in the summer vacation. I do not work during August, unless I have to. My suggestion would be that we agree upon an exchange of briefs, say, on the 20th of September, and then an exchange of reply briefs twenty days thereafter, and then come before your Honor and make an argument which will be a real argument.

THE COURT: I should like to hear it argued orally at some time.

MR. DAVIS: If your Honor please, I most strenuously object to that procedure. I shall be prepared to argue the case on Thursday, Friday or Monday, and I will be prepared to brief it within ten days, and submit it, and I think it would be a great hardship on all of us, including yourself, to let this thing go over until this trial has all gotten out of our minds, and we have to do this whole thing over again.

THE COURT: I had hoped and expected that this case might be argued, at least, roughly, at the close of the case, thereby assisting me in getting hold of the salient features of it. It is very complicated and unfamiliar to me, and I regret if any other course is suggested. I suggest to you that it might be possible from your point of view to do that, even if you do not do it with full prepara-

tion; and then, later on, in your brief you can deal with the points that you may not have fully covered or not covered at all. I do not expect you to cover all the points in your oral argument, which I would regard more or less as a rough argument.

MR. WILLIAMS: That is entirely satisfactory, if your Honor please.

MR. DAVIS: Then your Honor understands that we will argue it on Friday?

MR. WILLIAMS: Argue it on Friday. Get through on Thursday, and argue it on Friday.

THE COURT: Yes. Wait over night, even if you get through on Thursday afternoon.

MR. DAVIS: And about the briefs, we will decide on Friday.

THE COURT: Do that later. We will adjourn until Thursday morning at ten o'clock.

Whereupon at 5.00 o'clock an adjournment was taken until Thursday morning, July 5th, 1923, at 10.00 o'clock.

NINTH DAY

TRIAL RESUMED

Bangor, Me., July 5, 1923.
10:00 o'clock a. m.

Met pursuant to adjournment.
Parties present as before.

MR. DAVIS: If your Honor please, after the discussion which we have just had, the result is that the stipulation which I offered Tuesday night goes in, and I will have it written into the record.

THE COURT: It will be incorporated in the record.

MR. GARRISON: Yes, we will sign it. In connection with this stipulation just made by counsel for the defendant, we put upon the record some affidavits, which,

by stipulation, are to go in as if the witnesses had sworn to the facts therein, in detail, and there is an explanation (see page 540) in respect to this on the record.

THE COURT: Exactly.

MR. GARRISON: The affidavits I have just referred to were each made by Albert Roberts, the Secretary of the Minerals Separation North American Corporation, and respectively concern the following subject matters:

A list of the re-agents used by the American licensees of the company just named and facts in respect to the tons of ore treated, together with the tonnage figures of the operations under the licenses. Those had better be given exhibit numbers.

The following were received in evidence and marked "Plaintiff's Exhibit No. 17": Roberts affidavit giving list of re-agents used by American licensees, of Minerals Separation North American Corporation.

"Plaintiff's Exhibit No. 18": Roberts affidavit giving list of American licensees of Minerals Separation North American Corporation.

"Plaintiff's Exhibit No. 19": Roberts affidavit giving list of licensees and "Tons of Ore Treated."

"Plaintiff's Exhibit No. 20": Roberts affidavit giving summaries of "Tons of Ore Treated," "Tons of Concentrates Produced" and "Licensees Reporting Metals Recovered."

MR. WILLIAMS: Now, Mr. Higgins, please.

MR. DAVIS: If your Honor please, I object to the further continuation of the examination of Mr. Higgins. I understood we had finished with that Tuesday night.

MR. WILLIAMS: Mr. Higgins is recalled.

THE COURT: I had also. What is the idea?

MR. WILLIAMS: Mr. Higgins is recalled, first, to correct what he said as to pine oil solubility, which was based upon a hurried review during the luncheon hour of his notes; second, to amplify an answer that he made

to your question while on the stand, and, third, to put in some specimens which were not ready Tuesday, along the line of the specimens of the defendant.

THE COURT: If you do not go outside of that ground, it will be satisfactory.

ARTHUR HOWARD HIGGINS resumes the stand.

RE-RE-DIRECT EXAMINATION (Continued)

By MR. WILLIAMS:

RDQ. 757. Now, Mr. Higgins, in your testimony Tuesday in regard to the solubility of pine oil, did you make errors, and if so, please explain them with reference to the principal parts of the testimony where the errors appear.

A. Yes, in referring to notes during the recess I found a note giving the solubility of the pine oil at 0.14 per cent by volume, which I find now on re-calculating from the data there given is not very nicely expressed. It should be 0.14 or 0.15 per cent of pine oil dissolved in the water. That is to say, in 100 cc. there was 0.14 cc. of pine oil dissolved. On that corrected basis this 0.14 of a pound should be 0.14 percentage of solubility, on page 514, in answer to XQ. 602.

MR. DAVIS: Will you add there, Mr. Higgins, what that would amount to in pounds?

THE WITNESS: The recalculation there substantially agrees with the solubility given in the extract originally from the Miami Copper record. The same applies as to the figure 0.14 pounds in the next answer but one, and in answer to RDQ. 706 I was using this basis of 0.14 per cent. volume, which should have been 0.14 cc. dissolving in 100 cc., that would make the saturation point about twenty pounds to the ton of ore, so that answer would be somewhere about twenty pounds per ton of ore, and the following answer the same, roughly at the twenty-pound mark.

RDQ. 758. And with that figure of twenty pounds per ton of pine oil used, what amount of that twenty pounds

would go into solution under the conditions referred to in that testimony?

A. In a pulp of 4 to 1, that is, in 8,000 pounds of water, there would go into solution 11.2 pounds of the pine oil.

RDQ. 759. Have you said that the figure that was quoted to you from the Miami record was a correct figure or not?

A. Yes, that is a correct figure.

RDQ. 760. And what is the confusing element of the solubility of pine oil?

A. The fact that it is a mixture of substances, several of which are more soluble than others; some are completely insoluble, so that if one takes one-half a pound of pine oil and puts it into 8000 cc. of water, 55 per cent. of that half pound, a little more than half, will dissolve. The same if one takes one-tenth of a pound in 8000 pounds of water, a little more than half of that one-tenth of a pound will dissolve.

RDQ. 761. That is to say, there are insoluble elements there and soluble elements there mixed together; is that the condition?

A. Yes.

RDQ. 762. Now, at page 471, in answer to the question of the Court, Q. 345, the following appears—and I take only the part of it that is directly responded to:

> "Are there many inorganic substances that will do that?"

And the "that" was to produce this froth effect. You answered:

> "No, very few. There is only one that I know of, and that is sulphuric acid; under certain conditions with one particular ore it will give a froth."

Now, in the first place, we had been talking about salt. Did you mean one other?

A. Yes, I believe I said "one other."

RDQ. 763. Now, in the first place, when sulphuric acid was used in the Potter or Potter-Delprat process, did sulphuric acid act as a mineral-frothing agent?

A. No, not in my opinion.

RDQ. 764. Now, is there a patent which covers this use of sulphuric acid, for the purpose of producing a mineral-bearing froth?

MR. DAVIS: Your Honor, I object to that.

THE COURT: It seems to me to go outside the scope of the proposition on your part. Do you think it is important?

MR. WILLIAMS: It is an amplification of that answer. There happens to be a patent, the patent happens to be of a person who has testified in this record for the defendant.

MR. DAVIS: Perhaps I can simplify it. We do not dispute that sulphuric acid is a mineral-frothing agent.

THE COURT: Let him put it in in his own way. Put it in if you want to.

RDQ. 765. Read the question. (RDQ. 764 repeated as recorded.)

A. Yes, an Australian patent to Leslie Bradford, No. 632 of 1911.

MR. WILLIAMS: You will admit, will you not, that the Leslie Bradford to whom this patent was issued, is the Leslie Bradford that has testified as a witness for the defendant?

MR. DAVIS: Yes, I will.

MR. WILLIAMS: I offer that patent, Australian Patent No. 632 of 1911, application dated March 13, 1911, in evidence, as Plaintiff's Exhibit No. 21.

(Received in evidence and marked "Plaintiff's Exhibit No. 21."*)

RDQ. 766. Have you had specimens prepared for putting in evidence relative to some of the soluble mineral-frothing agents disclosed in the patent in suit?

A. Yes, I have.

RDQ. 767. Now, what are the first five bottles that are before you?

A. The organic frothing agents themselves.

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*Exhibit No. 21 withdrawn (see page 579.)

RDQ. 768. And will you name them in order?

A. Amyl acetate, phenol, benzoic acid, lactic acid and camphor.

MR. WILLIAMS: These are offered in evidence in the order stated as Plaintiff's Exhibits Nos. 22, 23, 24, 25 and 26.

(Received in evidence and marked "Plaintiff's Exhibits Nos. 22, 23, 24, 25 and 26.")

RDQ. 769. Now, what do these five bottles before you contain?

A. These are solutions of the mineral-frothing agents, the first one being amyl acetate of a 0.1 per cent solution as given in the example in the patent in suit, equal to 1 part in 1000 of water; a phenol solution of 1 part in 4000 of water; a benzoic acid solution of 1 part in 4000 of water; a lactic acid solution of 1 part in 4000 of water; camphor solution of 1 part in 4000 of water.

MR. WILLIAMS: These are offered in evidence in the order stated as Plaintiff's Exhibits 27, 28, 29 30 and 31.

(Received in evidence and marked "Plaintiff's Exhibits Nos. 27, 28, 29, 30 and 31.")

RDQ. 770. Now, this specimen of lactic acid, what happens to that when you shake it or agitate it?

A. There are a few bubbles entrapped in the liquid, which is somewhat viscous, like glycerine.

RDQ. 771. What happens to the solution when you shake it?

A. There is a tremendous increase in the number of bubbles introduced into the liquid, and a froth of the solution forms on the top, which gradually breaks down.

RDQ. 772. And what is the character of those bubbles as to size?

A. They are exceedingly minute.

RDQ. 773. What happens to the pure amyl acetate when you shake it?

A. A few bubbles are entrapped in the water, which rise quickly in amyl acetate. It looks very much like clean water on shaking it.

RDQ. 774. Now, what happens to the solution of the amyl acetate?

A. Practically the same thing as happens to the solution of lactic acid, a tremendous increase of bubbles entrapped in the liquid. They are exceedingly fine bubbles, and a froth of the liquid forms on the surface.

RDQ. 775. In what condition is the phenol specimen, pure phenol?

A. In a crystalline solid, colorless.

RDQ. 776. And the benzoic acid?

A. Crystalline solid, flaky in appearance, white in color.

RDQ. 777. Did you try to get a specimen of valerianic acid?

A. Yes, I was only able to obtain the iso valerianic acid as the tri-hydrate, which was not acceptable to me.

RDQ. 778. What did you wish to obtain?

A. I wanted to obtain the normal.

RDQ. 779. And that is the substance that appears in the chemical textbooks as valeric acid with a little "n" after it?

A. Yes, it is.

RE-RE-CROSS-EXAMINATION.

By MR. DAVIS:

RXQ. 780. If I understand it, Mr. Higgins, if you took 1 part of pine oil to 4000 parts of water and mixed them together as you have, to form this 1 part in 4000 solution of the exhibits, at least one-half of that pine oil would go into solution.

A. Yes.

RXQ. 781. And then when you shook up the solution it would form the small bubbles such as you have just described?

A. Yes, it would. At the same time the solution would not clear like this did. You would have a milky appearance, due to the undissolved pine oil.

RXQ. 782. That is, the dissolved pine oil would bring about the formation of the small bubbles, and the undissolved would remain there as an emulsion until it settled out?

A. Yes.

RXQ. 783. And if you used 20 pounds of pine oil to a ton of ore in the ordinary mill practice, as I understand, about 11 pounds of the pine oil will go into solution in the pulp, is that right?

A. Yes.

RXQ. 784. And that dissolved pine oil in the pulp will perform all of the functions of a soluble frothing agent, as described in the patent in suit?

A. Yes.

RXQ. 785. And you mentioned as the effect of the soluble frothing agent in your testimony on Tuesday, pages 473 and following, the fact that the soluble frothing agent forms or assists to form a very large number of minute bubbles, and also the fact that it brings about a greater ease of attachment of the bubbles to the mineral particles, is that right?

A. Yes.

RXQ. 786. And those effects would be produced by this 11 or so pounds of pine oil that would exist in solution in the mixture which I have spoken of?

A. Yes.

RXQ. 787. And the same is true of these tar oils which contain phenols and cresols?

A. With regard to the effect, yes.

RXQ. 788. Is pine oil an artificial mixture or a natural mixture?

A. It is artificial in the sense that it is a product of distillation of pine wood, but it is natural in the sense that it is not made up deliberately by mixing a soluble with an insoluble material.

RE-RE-DIRECT EXAMINATION.

By MR. WILLIAMS:

RDQ. 789. I think that it was put to you, in ordinary mill practice with 20 pounds of pine oil to a ton of ore. Do you accept that?

A. No, that would be most extraordinary mill practice.

THE COURT: In what respect?

THE WITNESS: The use of such an amount of oil

This oil is very expensive. It costs at the present time about $1 a gallon. That is about eight pounds per dollar. In ore concentration people could not stand the use of 20 pounds per ton.

RDQ. 790. And aside from the question of cost, what, based upon your experience, would be the result of using 20 pounds of pine oil to the ton of ore?

A. As I remember, I have never seen such an operation carried out, but, judging from other experiments I have seen with 20 pounds of mixture of soluble and insoluble constituents, a result would be obtained which would be of less metallurgical value than with the use of, say, 2 pounds of that same mixture, or in this case it would be 2 pounds of pine oil.

RDQ. 791. I think you testified before that the normal quantities were a certain amount, the normal quantities of pine oil used in mill practice?

A. Yes.

RDQ. 792. What are they?

A. They are very small, half a pound and less. Even less than one-tenth of a pound is used, in conjunction, of course, with some other oil.

RDQ. 793. Have you in mind any instance where pine oil has been used alone?

A. Yes.

RDQ. 794. And in what amount?

A. If I remember correctly, pine oil was used alone at Elm Orlu mill in about half a pound to three-quarters of a pound per ton for a good many months. I do not know whether it is still in use there or not.

MR. WILLIAMS: That is all.

RE-RE-CROSS-EXAMINATION.

By MR. DAVIS:

RXQ. 795. When was that, Mr. Higgins?

A. I believe that was in 1917.

MR. DAVIS: That is all.

MR. WILLIAMS: Mr. Chapman. Mr. Chapman was sworn before.

THE COURT: I believe he was.

GEORGE ALBERT CHAPMAN, called as a witness on behalf of the plaintiff in rebuttal, having been previously sworn, testified as follows:

DIRECT EXAMINATION.

By MR. WILLIAMS:

MR. WILLIAMS: Will you admit that Mr. Chapman is a duly qualified metallurgist?

MR. DAVIS: I think you should show his practical experience, Mr. Williams.

Q. 72. Mr. Chapman, what, generally, has been your experience in metallurgy, and you may tell me when you began to be a metallurgist; how long have you been a metallurgist?

A. Since 1899.

Q. 73. What generally has been your experience in the froth-flotation process of concentrating ores? Over what period of time has it extended?

A. From 1905 onward.

Q. 74. Have you installed the froth-flotation process of concentrating ores in various places over the world?

A. Yes, in many places.

Q. 75. Where did you first install that process?

A. The Central Mine, Broken Hill.

Q. 76. Australia?

A. Yes.

Q. 77. And when did you there install it?

A. In the latter half of the year 1905.

Q. 78. How long did you remain in Australia after that installation?

A. To 1908. I left Broken Hill in or about the month of June, 1908.

Q. 79. In how many plants was the air-froth-flotation process installed during that period?

A. Six plants.

Q. 80. What mineral-frothing agent was used in the commercial operations in these plants during this period of about three years?

A. In all of the plants, oleic acid.

Q. 81. And generally, in what proportion?

A. In the proportion of 1½ to 2 pounds per long ton of ore treated.

Q. 82. And the long ton is how many pounds?

A. 2240 pounds.

Q. 83. What were the conditions in those plants, as to cost of water?

A. The water supply to the plants was very expensive. We had to pay at the rate of 5 shillings for 1000 gallons, or the equivalent at that time of roughly $1.25 per 1000 gallons of water.

Q. 84. And under this very high cost of water, how were the plants operated in regard to the water supply?

A. The plants were operated in a closed circuit. In other words, the only water that was lost was the water lost by evaporation, by seepage, and what went out in the form of moisture on the tailings and concentrates shipped from the mill.

Q. 85. How much water was used in the plant per ton of ore?

A. Roughly a little over three parts of water to one part of ore. That is to say, for every ton of ore we would use three tons of water in circulation with the pulp.

Q. 86. That would make 6720 pounds of water to one ton of ore?

A. Yes.

Q. 87. Of that 6720 pounds of water to the ton of ore, how much was returned circuit water, and how much was fresh water?

A. Our loss of water or the water to make up the constant volume of the circuit amounted to less than 100 gallons per ton. In some instances as low as 66 gallons per ton. Taking the figure of 100 gallons per ton, the high figure, we used 1000 pounds of fresh water with 5720 pounds of the returned circuit water, making a total of 6720 to the long ton of ore.

Q. 88. Did you have any experiences in these plants where the supply of oleic acid was cut off?

A. Yes.

Q. 89. Were they intentional or accidental?

A. Both.

Q. 90. What happened when the supply of oleic acid was cut off?

A. In a few minutes the froth on the first spitzkasten would diminish in quantity, and in about 10 or 12 minutes totally disappear.

Q. 91. What was the general nature of these ores in Broken Hill which were treated in these plants, what kind of an ore?

A. In five of the plants the ore treated was the tailings from the water-concentration process. In four of them were treated the dump tailings which had been on the surface for many years. The fifth was treating the current tailings from an existing concentrator, and the sixth was for the purpose of treating dump slimes which had also been on the surface for many years.

Q. 92. And these dump tailings and dump slimes contained about what zinc content and lead content?

A. In the plants of the Central Mine, Broken Hill, I should say a rough average of 20 per cent of zinc. In the fifth plant, which was upon the British mine, about 15 per cent of zinc. In the plant treating the slimes, about 15 per cent lead, and about 18 to 20 per cent of zinc. These figures are only approximate.

Q. 93. The principal metallic constituent was zinc?

A. Yes, in all except the slimes plant, where the lead was quite an important mineral.

Q. 94. And was there any other metallic constituent of value in these dump tailings?

A. Yes, because it had the valuable silver associated with both the blende and the galena.

Q. 95. So that the valuable minerals present were zinc, lead and silver?

A. Yes.

Q. 96. Were they or were they not recovered, in these froth-flotation plants?

A. Yes, they were recovered.

THE COURT: This operation was successful financially, was it?

THE WITNESS: Very successful.

Q. 97. After you had come back from Australia, did you go to other parts of the world and install this process?

A. Yes, sir.

Q. 98. When did you first have anything to do with an installation and use of the process on porphyry ores?

A. At the time we installed the testing plant at Joe Bush shaft, at Inspiration Mine.

Q. 99. In Arizona?

A. In Arizona.

Q. 100. And when was that?

A. That was in the first week in January, 1913.

Q. 101. And how big a plant was installed at that time, as to capacity?

A. The capacity of the plant was rated at 50 tons per day, but our work was mostly done in one shift and on 10-ton lots of ore from various parts of the mine.

Q. 102. That is to say, you ran the plant for a limited time every day, instead of running it continuously?

A. Yes, we treated 10 tons per day, and that would be done in a few hours.

THE COURT: The miners worked 8, 10 or 12 hours each day?

THE WITNESS: The miners worked 8 hours, or were supposed to work 8 hours.

Q. 103. The miners worked 8 hours in a shift, and there were three shifts, is that it?

A. Yes.

Q. 104. So that the work goes on all day?

A. Yes.

Q. 105. Now, what mineral-frothing agents were used in this 50-ton plant at the Inspiration Mine at the period that you have spoken of?

A. Mainly cresylic acid.

Q. 106. Which is——

THE COURT: What is that?

A. Cresylic acid, known as cresol.

Q. 107. Were those operations successful?

A. Very. As a result of those operations a larger test plant was built, and eventually a large mill of a capacity of roughly 16,000 to 18,000 tons per day.

Q. 108. That is the second test plant. What was its capacity?

A. Its rated capacity was 600 tons per day.

Q. 109. Did you see that and participate in the operation of it?

A. Yes, I saw that plant in operation early in 1914.

Q. 110. Have you seen that mill in operation that you have spoken of as the final result of those tests?

A. Yes, many times.

Q. 111. This test plant employed what sort of agitation?

A. The agitation that takes place in the Standard Minerals Separation machine; that is, the agitator consisted of a four-armed agitator.

Q. 112. Rotating four-armed agitator?

A. Yes.

Q. 113. Followed by a spitzkasten?

A. Yes.

Q. 114. And a number of these agitators and spitzkastens made up the apparatus; is that right?

A. Yes.

Q. 115. And was there anything in the way of a sub-aeration apparatus tested?

A. Yes, there was a Hebbard sub-aeration machine tested.

Q. 116. Now, when the mill was installed, was a sub-aeration machine installed in the mill?

A. No, I think not, at the beginning. That was a later installation.

Q. 117. But there was a sub-aeration machine installed there?

A. Yes.

Q. 118. And did that have the impellers at the bottom.

A. Yes.

Q. 119. And took the froth off the top of the same vessel?

A. Yes.

Q. 120. And the air, where was that introduced?

A. Under the impeller.

Q. 121. Are you familiar with the type of froth-flotation apparatus, in which air comes in to the bottom through a porous medium?

A. Yes.

Q. 122. What was the final type of apparatus used at the Inspiration Mill for treating this 16,000 to 18,000 tons per day?

A. There were two types of pneumatic machines installed. Out of the 16 or 18 sections, I believe there were five or six which had the standard Callow type of cell installed, and the rest were the Inspiration cell.

Q. 123. Which also had a porous, canvas bottom?

A. Yes.

Q. 124. And was it of the same type as the Callow?

A. Yes, except it was much longer.

Q. 125. What mineral-frothing agent was in use at this Inspiration Plant when you last saw it in operation, or has it got down to any standard, and what is it?

A. I believe the last time I saw the plant in operation, it was operated on coal-tar and a coal-tar creosote, but that I cannot be certain of.

Q. 126. In general, what has been the frothing agent used in this plant, of the coal-tar creosote variety?

A. Of that general type, yes.

Q. 127. Among the licensees of the plaintiff appears the Utah Copper Company; have you seen their mill in operation?

A. Yes, I have seen the Magna Mill in operation. They have two mills, the Magna and the Arthur, and I have not been over the Arthur Plant.

Q. 128. That is a porphyry ore?

A. Yes.

Q. 129. Where do they get the ore from in that case, a mine?

A. I understand the ore treated in this mill came from an open cut.

Q. 130. Practically a mountain, is it?

A. Yes.

Q. 131. Of ore?

A. Yes.

Q. 132. Now, what type of flotation apparatus is used in that mill, and I will just say generally is it of the mechanical agitation type or the pneumatic type?

A. It is of the mechanical agitation type.

Q. 133. In the list of agents used in connection with flotation, I see such a substance as fuel oil. Is fuel oil capable of being used in a mill operation in the froth-flotation process of concentrating ores?

A. No.

Q. 134. What has to be associated with it?

A. A mineral-frothing agent.

Q. 135. And what kind of a mineral-frothing agent is used with it? That is, is oleic acid used?

A. I know of no installation where oleic acid was so used.

Q. 136. And generally what are the substances used?

A. A soluble or a partially soluble mineral-frothing agent.

Q. 137. Now, kerosene acid sludge is described as one of the frothing agents. Are you quite familiar with the use of that mineral-frothing agent?

A. Yes.

Q. 138. At what great installation were you connected with its use?

A. The installation at Anaconda in Montana.

Q. 139. Did you spend some years there installing it?

A. Yes.

Q. 140. How long, in general?

A. Oh, two or three years, with intervals of being away visiting other plants.

Q. 141. What is the capacity of that plant in copper ore?

A. Do you mean as far as flotation is concerned?

Q. 142. Tons of material treated per day.

Mr. Garrison: By flotation.

Q. 143. By flotation.

A. Between 11,000 and 12,000 tons a day of flotation feed per day.

Q. 144. Is there a zinc mill?

A. Yes.

Q. 145. Does that treat the zinc ore?

A. Yes.

Q. 146. What is the capacity of the zinc mill?

A. Around 2,000 tons per day.

Q. 147. Is that a flotation mill?

A. Yes, that is a unique mill. The only method employed is flotation. There is no other concentration device in the plant.

Q. 148. No water concentration at all?

A. Absolutely none.

Q. 149. So that it is an all-flotation mill?

A. Yes.

Q. 150. Now, kerosene acid sludge, is that a partially soluble re-agent, or a wholly soluble re-agent?

A. The kerosene acid sludge used at Anaconda during my stay there was an acid sludge that was soluble in water.

Q. 151. Wholly soluble?

A. Wholly soluble in water. We did experimentally use other acid sludges, which contained an insoluble constituent, but the main agent used was acid sludge from the Union Oil Company, and was known as M. S. No. 37.

Q. 152. That was a waste product, was it not, before it was used in flotation?

A. Yes.

Q. 153. I notice copper sulphate appearing as one of the materials used in flotation. Is that used as a mineral-frothing agent?

A. No, I should call the use of that to be the use as a gangue-corrective.

Q. 154. I notice that at the Butte and Superior, which is one of the licensees, the materials used in flotation are stated to be G. N. S. No. 5 pine oil, copper sulphate and sulphuric acid. Is the function of the copper sulphate there what you have stated?

A. Yes.

Q. 155. What is the function of the sulphuric acid there?

A. It is for the same purpose.

Q. 156. I notice the California Rand Silver Mine, another licensee, gives the material sodium carbonate or sodium silicate. Is that a frothing agent or a gangue-corrective?

A. They are gangue-correctives.

Q. 157. The Cascade Silver Mines and mills give sodium sulphide. What is that, a frothing agent or a gangue-corrective, or what is it, the other materials being cresol and pine oil?

A. I have no personal experience with this actual ore or the re-agents used for the treatment of it, but it is my opinion that the sodium sulphide is used to produce a cleaning effect of the mineral, which may possibly be tarnished, and sodium sulphide is very often useful for that purpose.

Q. 158. Removing the oxide or whatever tarnish there is?

A. It may partially remove or coat the oxide; that I do not know.

Q. 159. Now, I notice that the Consolidated Copper Mines Company is described as using X-cake, xylidine and lime; what function does lime perform in that combination?

A. I should say that that was a gangue-corrective.

Q. 160. And having in mind the defendant's operations as they have been set forth here, what is your opinion as to the function of the lime in the defendant's operations?

A. It is for the same purpose, as a gangue-corrective.

By The Court:

Q. 161. What do you mean by "a gangue-corrective"?

A. In flotation operations in general, one of the difficulties encountered is the flotation of gangue with a mineral-bearing froth, and we find that by adding certain substances, such as sodium carbonate, lime, it improves the operation and cuts out quite a lot of the gangue from the froth. That is really the chief use of sulphuric acid in these operations.

Q. 162. How does it operate, how does it do that?

A. I do not know, and I do not believe anybody has proved what it actually does except that it does it. There is

another use for the so-called gangue-correctives, which is very important; in some ores, when agitated with re-agents—

Q. 163. By "re-agents" you mean flotation agents?

A. Flotation agents, the slimy portion of the pulp becomes very badly coagulated, and locks up the sulphide mineral particles, and to prevent that locking up in the floccules these gangue-correctives are added to prevent that flocculation. That is another very important use of it.

By Mr. Williams:

Q. 164. In all your experience, do you know of any instance where porphyry ores have been successfully treated with an insoluble mineral-frothing agent?

A. No.

Q. 165. And what is your experience as to these porphyry ores, what kind of a mineral-frothing agent is used?

A. A wholly soluble or a partly soluble mineral-frothing agent is used.

Q. 166. And when were porphyry ores first treated by the froth-flotation process?

A. In January, 1913.

Q. 167. At the Inspiration Mine?

A. Yes.

Q. 168. And you have given the flotation agent there—cresol, is used, is that right?

A. Yes, cresol with other materials.

Q. 169. It is a mere repetition, but how do you class cresol—as a soluble mineral-frothing agent?

A. As a soluble mineral-frothing agent.

Q. 170. Now, there will appear—

By The Court:

Q. 171. Organic substance?

A. Yes

Mr. Williams: Now, there will appear in the record some references to bottle tests, carried on in the laboratories for froth-flotation operations. Will you describe how those bottle tests are carried on? You may illustrate with a bottle here, if you will.

The Witness: I usually take a bottle slightly small-

er than this bottle I hold, usually four or six ounces, I believe.

By Mr. Williams:

Q. 172. The bottle you hold being Plaintiff's Exhibit No. 31.

Mr. Garrison: What is that, an eight ounce bottle?

Q. 173. What is this bottle?

A. I should say this is about eight ounces. In that bottle I would place ten to fifteen grams, roughly, of the ore to be treated, and add to that ore three or four times the amount of water, and would then add a mineral-frothing agent which I would consider suitable for the ore, and violently agitate it by shaking, roughly 100 shakes per minute (illustrating). I would allow the bottle to come to rest, and an indication would be given by the amount of mineral-froth that would float upon the top of the pulp. This, of course, is not a method of obtaining ideas of the recovery that would be obtained, but it would give a good indication whether that particular ore would work with that particular mineral-frothing agent.

By The Court:

Q. 174. You will reject a good many substances?

A. Yes, sir.

By Mr. Williams:

Q. 175. In the process of selection, that is a quick and simple method, is it not?

A. Yes, I find that exceedingly useful. It was so on one occasion in Sweden. I took with me to Sweden many expensive flotation or mineral-frothing agents; and when I arrived at the mine, the Saxbergets Mine in Sweden, I determined that a local wood-tar was being produced and produced very cheaply. I did one of these small tests in the absence of a proper testing machine, and decided that it was a very good mineral-frothing agent for that particular ore; and I had no occasion to use these expensive re-agents which I had brought from England with me.

Q. 176. And when was that?

A. That would be in or about July, 1912.

Q. 177. You did not tell how long this bottle test took from the commencement of the shaking of the bottle; that is, how long you agitated the material in the bottle. You gave the rate of agitation but not the time.

A. I would shake that from between half a minute to one minute. That would be sufficient to give a general indication.

MR. WILLIAMS: Direct-examination closed.

CROSS-EXAMINATION

BY MR. DAVIS:

XQ. 178. Oleic acid has never been used successfully as a flotation agent in porphyry copper ores, has it?

A. No, not to my knowledge.

XQ. 179. Your work since 1905 in flotation has been directly in conection with the Minerals Separation, Limited, or Minerals Separation North American Corporation?

A. Yes, and its allied companies, such as Minerals Separation American Syndicate (1913), Limited.

XQ. 180. And between the time you entered that employ in 1905, and the year 1907, did you familiarize yourself with the laboratory work in London conducted by Mr. Sulman?

A. I was in Australia at the time.

XQ. 181. You had not been in London in the laboratory up to 1907?

A. No. It was the middle of 1908 when I returned to London.

XQ. 182. And in Australia you were working with this flotation process?

A. Yes.

XQ. 183. And receiving instructions from London?

A. Yes. I was receiving instructions at the beginning from London through Mr. Courtney.

MR. WILLIAMS: I will just say to your Honor that we put in a stipulation about the employment of Mr. Chapman covering the entire period, and that is why I did not enlarge upon it in his examination. You have not had the stipulation read to you.

XQ. 184. You worked in the laboratory of Sulman and Picard before you went to Australia?

A. Yes

XQ. 185. In this Treatise, on page 220, Mr. Sulman says, referring to the Sulman, Picard & Ballot British Patent No. 7803 of 1905—he says it is:

"Generally known as the 'Froth process' or the 'oleic acid froth' process owing to the ready separations given by this particular oil."

And then there is a footnote:

"A variety of oils is now found to yield the same froth."

Does that agree with your knowledge on the subject?

MR. WILLIAMS: I think you should put to the witness the time of this publication. You have not put it to him, and he does not know what "now" means.

MR. DAVIS: The date of the Treatise was 1907.

MR. WILLIAMS: I wish to correct a slip of the tongue. I called it a publication. It never was published.

THE COURT: All right.

THE WITNESS: May I have the question read?

(XQ. 185. repeated as recorded.)

A. No, because my knowledge of the flotation art at that time—and when I say "flotation art" I mean the frothing flotation art—was confined entirely to Australia, and there the only re-agent or mineral-frothing agent I used was oleic acid.

XQ. 186. But you knew that in the mineral separation art generally other agents, oils, or oily substances having a preferential affinity for the metalliferous matter had been used, did you not?

MR. WILLIAMS: If your Honor please, is this cross-examination on the literature of the art of froth-flotation?

THE COURT: I am a little bit uncertain about the scope of it myself.

MR. DAVIS: The direct examination seemed to me to be intended to make it appear that oleic acid was the only known flotation agent at these early dates, and I want to show that that was not the fact.

MR. WILLIAMS: If your Honor please, the direct examination showed that in the practical experience in Australia, oleic acid was the material used. The witness is now being cross-examined on the literature of the art, as to which he has not testified.

THE COURT: The literature is incidental of what his main object is.

MR. WILLIAMS: It seems to me that the cross-examination should be directed to the practical use in the art of froth-flotation, of which the witness has testified.

THE COURT: This may bear on that. Of course you will observe the rule.

MR. WILLIAMS: Exception.

(XQ. 186. repeated as recorded.)

A. But my present recollection is that I did not.

XQ. 187. You testified in answer to Mr. Williams' question that the installation finally made at the Inspiration Mill was an installation of pneumatic cells. Actually that was the installation initially made at the mill, was it not?

A. Yes, at the big mill.

XQ. 188. And you did not mean it to be concluded from what you said about the use of cresol in the tests, that that was the agent used in the mill?

A. No. I never intended to give that impression.

XQ. 189. As a matter of fact, they used not only coal tars but also wood tars in the mill, did they not?

A. Yes, that is true.

XQ. 190. You testified that as far as you know, fuel oil alone had never been used as a flotation agent. Is that true of this MSFO which you say was Minerals Separation Fuel Oil?

A. Well, when I was speaking of fuel oil, I was referring to the use of the kerosene type.

XQ. 191. That does not include this MSFO?

A. No.

XQ. 192. And the MSFO was an oil which could be used alone as a flotation agent?

A. Yes, it could be used alone, and I have seen it used alone, but with very poor results.

XQ. 192. But it contained a soluble constituent which went into solution in the pulp?

A. That I understand to be the fact.

XQ. 193. You spoke of some substance being wholly soluble in water. I take it you meant that when used in the proportions of the flotation art, that is approximately 1 part to 4000, it went wholly into solution, is that right?

A. Yes.

Mr. Davis: That is all. Before I sit down, I want to say, if your Honor please, since this Anaconda license has been referred to and the Utah license, the facts that went into the stipulation are these: so far as copper ores are concerned, the Anaconda license expires with the expiration of the first patent 835,120. It contains a clause under which it may be renewed on the option of the licensee. All of the other large porphyry companies, including the group that effected the settlement after the Miami accounting litigation, their licenses provide that they may do whatever Anaconda decides to do, and on looking over these figures I find that of the 169,000,000 tons of ore treated, 160,000,000 were treated by these licensees whose licenses expire with the expiration of the first patent.

Mr. Williams: And of course they are the great porphyry companies. Just one thing more to fill out the facts; the first patent expires on November 6th of this year.

The Court: I understood so from previous testimony.

Mr. Garrison: That concludes our oral testimony, if your Honor please. I now desire to offer in evidence the various documents which were presented by me when cross-examining Theodore J. Hoover in the deposition that is in evidence, and which were marked by the officer before whom that deposition was taken, with the numbers which I now desire to have admitted in evidence in this case.

The Court: What have you done about that deposition? There is some question about it?

MR. GARRISON: No, none about the deposition. We stipulated that into this case, and now I wish to have it accompanied by the documents that were identified by Mr. Hoover, but could not then be put in, because he was not our witness, and these will all be given appropriate numbers here. I have them all here, and the stenographer and Mr. Lewis will fix that up.

THE COURT: That is a matter of detail.

(The Plaintiff's Exhibits above referred to were received in evidence, and the numbers and descriptions thereof appear at the end of today's record.)

MR. WILLIAMS: During the cross-examination of Mr. Yerxa, I had two exhibits marked for identification. I now offer them in evidence.

MR. DAVIS: What are they?

MR. WILLIAMS: They were marked Plaintiff's Exhibits B and C for Identification.

THE COURT: They may be admitted.

Plaintiffs' Exhibits B and C heretofore marked for Identification, were received in evidence and marked Plaintiff's Exhibits Nos. 102 and 103.

MR. WILLIAMS: In the opening part of this case, we offered in evidence a copy of the bill of sale, which was received subject to correction on comparison with the original. Is that copy accepted now?

MR. NEARY: I thought we agreed. You mean the one that had the Companies Act on it?

MR. WILLIAMS: No, the bill of sale.

MR. NEARY: We have no objection to the offer.

MR. WILLIAMS: The record shows that it was received, subject to comparison.

MR. DAVIS: I take it it is always subject to comparison with the original.

MR. GARRISON: That merely means if we find some mistake, we will call it to the Court's attention, and correct it.

THE COURT: Have you compared it?

MR. GARRISON: Mr. Davis and I understand it is in, only either side can come to your Honor—

THE COURT: You mean it is subject to comparison?

MR. GARRISON: Yes, it is in absolutely, but it is subject to be corrected by comparison with the original.

MR. WILLIAMS: I offer in evidence a certified copy of the file wrapper, and contents of the patent in suit No. 962,678, marked Plaintiff's Exhibit No. 104. The defendants having offered in evidence the patent to John M. Callow, No. 1,329,335, I offer in evidence a certified copy of the file wrapper and contents of that patent.

Received in evidence and marked "Plaintiff's Ex. No. 105."

MR. WILLIAMS: The defendants having offered in evidence a license agreement under which they justify, having put in one of the patents mentioned in that license agreement I offer in evidence four other patents to John M. Callow which are mentioned in that license agreement, and they are describable as follows:

1,124,856, of January 12, 1915; 1,125,897 of January 19, 1915; 1,141,377 of June 1, 1915; 1,182,748 of May 9, 1916, all to John M. Callow.

Received in evidence and marked "Plaintiff's Ex. No. 106 (patent No. 1,124,856); No. 107 (patent No. 1,125,897); No. 108 (patent No. 1,141,377); No. 109 (patent No. 1,182,748).

MR. WILLIAMS: Since it appears in the file of the particular Callow patent for the Callow cell which the defendant relies upon, that there was another application for a United States patent, which is to some extent described in that file, but on which no patent was ever issued in this country, I have found the Canadian patent, which corresponds to that description, and I offer in evidence a certified copy of that Canadian patent No. 160,689, bearing date February 16, 1915, granted to Metals Recovery Company, Assignee of John M. Callow.

MR. DAVIS: I want to object to this last exhibit, because I do not know what it is put in for. It is not one of the patents under the license.

MR. WILLIAMS: No; the Canadian patent discloses

very clearly the invention which is referred to in the file of the Callow patent for the pneumatic cell which the defendant used, and since it so happens that that application there referred to never became a patent in the United States, I am putting in the available publication, the Canadian patent, and it will be found to correspond to what is described in this file wrapper.

MR. DAVIS: It seems to me, the fact that it never became a patent here is a reason why it should not go in. I do not see the relevancy.

THE COURT: I will let it in.

Received in evidence and marked "Plaintiff's Ex. No. 110.

MR. WILLIAMS: Of the exhibits that have been offered in evidence by the defendant, having in mind that certain of the patents referred to were set up in the answer and certain of them were not set up in the answer, and that it is my understanding that those that are not set up in the answer are not put in as anticipations, the only objection that I have is to the file wrapper and contents of patent No. 1,099,699, Henry Howard Greenway, of June 9, 1914. I may say that by putting in the file wrapper of that patent they also put in the patent, because it is attached to it; and here is a patent to one of the patentees of the patent in suit, issued a long time after the issuance of the patent in suit issued, and my first objection to that patent or its file wrapper is that it is irrelevant for any purpose, a subsequent patent by one of the patentees of the patent in suit, who has assigned his invention to the plaintiff. That is my first objection.

My second objection to it is that this file wrapper and contents contain affidavits which are thus brought in as though they were evidence, and as well, statements of the patentee's representative or attorney, which are brought in all for the purpose of calling to the attention of your Honor certain facts which the defendant will rely upon.

THE COURT: Is there any question about that being subsequent in date?

MR. DAVIS: It is subsequent in date. This patent actually issued to the present plaintiff.

THE COURT: One of them?

MR. DAVIS: To the American company.

THE COURT: To the plaintiff.

MR. DAVIS: And it contains declarations both of their counsel and affidavits by Mr. Greenway, one of the inventors of the patent here in suit, the affidavit being filed by counsel for the plaintiff in that proceeding, and the fact shown by the affidavit and the statement are that they were unable to get a mineral-bearing froth with the organic agents in solution with the patent here in suit, except in acidified pulp and it was upon that representation and that affidavit that the Patent Office issued them a patent, this patent here, for the leaving out of the acid from the pulp. It seems to me it is the best evidence in the world.

MR. GARRISON: It may be good evidence to offset the second patent, but I do not see what effect it has on the first, the patent in suit, the patent and the file wrapper on which the application was made. How could it affect the first patent—a declaration after that patent was fully effective?

MR. DAVIS: It is a declaration precisely contrary to the position taken in this litigation.

MR. GARRISON: It seems to be issued to a third party. How can this inventor slander the title that he has already conveyed to a third party?

MR. NEARY: He was acting as the agent.

MR. GARRISON: What did you say?

MR. NEARY: He was acting as the agent of the party.

MR. DAVIS: It was assigned to the Minerals Separation North American Corporation.

MR. WILLIAMS: No, it is issued to Minerals Separation, Limited, of London. It appears right on the face of the patent; not issued to this plaintiff at all. We have had that before, your Honor.

MR. DAVIS: It is true that this was issued to the

Minerals Separation, Limited, but the record shows, these papers that have been filed, that it is the property of this plaintiff. It was asserted in the Third Circuit as a valid patent. It was the basis of the suit and was held to be a valid patent in the Third Circuit, and it was issued, and this monopolistic right was granted to these plaintiffs upon a representation which is absolutely opposed to the representation that they are now making before your Honor, and it seems to me that no better evidence is conceivable than that—a declaration made by a party in interest at a time when he did not have the interest to declare something else, that he now has.

Mr. Garrison: Who do you claim is the party in interest that made that declaration?

Mr. Davis: It was Mr. Williams who made it.

The Court: How do you connect it with this plaintiff here?

Mr. Davis: The connection I make is this: I cannot get the dates just right, but the connection is this—that this declaration was made by the person who was seeking to get the grant of this monopoly. That monopoly is now in the possession of this one plaintiff, the Minerals Separation North American Corporation—

The Court: What of it?

Mr. Davis: That it has been asserted by that plaintiff as a valuable property right, and I think that the declarations, the conflicting declarations, of their predecessor, are binding upon them.

The Court: I do not see how that makes it admissible.

Mr. Neary: The statements were made by this party while they had title to the property, and statements made at that time are chargeable against the successor in title. That is, the declarations or admissions made by the party having title are admissible in evidence against the successor in title in a proceeding wherein the successor in title is taking a position inconsistent with the statement made.

THE COURT: This is the other patent.

MR. GARRISON: That is his trouble. He is mixing up the patents.

MR. NEARY: But it is with regard to the title to this patent.

THE COURT: I do not get you on that.

MR. NEARY: The statements are made in the patent with regard to the subject matter and the title to the patent in suit.

MR. GARRISON: No. The proceeding was not in respect to that.

MR. NEARY: That does not make any difference. The rule is, as I understand it, that if the declarations or admissions are made with regard to the subject matter of the suit, it is immaterial where they are made or how they are made. I say that these statements are made at the time, with regard to the subject matter in suit.

THE COURT: Not by this party?

MR. NEARY: By the person who at that time had title to both the patent in suit and to this patent.

MR. GARRISON: No.

MR. WILLIAMS: No.

MR. NEARY: Yes, that is true; at the time that these statements were made the title to the patents in suit, the legal title, was in Minerals Separation, Limited, and the beneficial title was in the North American Corporation or the North American Syndicate; so that at the time that these statements were made, you had a situation where the title was held by Minerals Separation, Limited, the legal title was held by them, and the beneficial title was in the possession of, we will say, the American Corporation, the plaintiff in this suit. Now, under those circumstances you have statements made with respect to the title to the patent in suit not with respect to anything else. We are not offering it with respect to the third patent, but as affecting the title to the patent in suit, and it is a statement inconsistent with the position that they are taking now with regard to the patent in suit.

THE COURT: The statement was not made by the present party in interest now suing.

MR. NEARY: But it was made by the person who at the time had the interest, and it was made by an agent; that is to say, this property, the property in the patent in suit, as well as the property in the application then pending, was in Minerals Separation, Limited, as a legal title—as a legal titleholder, and in the plaintiff the North American Corporation, as the beneficial holder, and any statements that were made, were made as agents of both of those corporations; so that we can say properly that at the time that that statement was made, it was made by the agent of the plaintiff in this suit; but you do not have to go that far. If it had been made by the agent of Minerals Separation, Limited, and subsequently the title had come into the North American Corporation, then those statements made by the privy in title would be effective against the plaintiff in this suit.

THE COURT: Involved in another patent?

MR. NEARY: Your Honor, the proceeding was with regard to another patent; but we are offering it for the purpose of showing the statements made with regard to the patent in suit.

MR. GARRISON: It was made by one of the inventors, in trying to obtain a patent on a new discovery.

MR. NEARY: That does not make any difference about it being made by the inventor. The statement was made by the person who was prosecuting the matter before the Patent Office. The statements are made by counsel for the parties. The parties were Minerals Separation, Limited, and the beneficial owner, namely, the plaintiff in this suit. Now, all the statements that were made in that proceeding with regard to the patent in suit are statements—if they are inconsistent with the position which is now being taken with regard to the patent in suit—admissible in evidence in order to show that fact.

THE COURT: You say that this plaintiff was then the beneficial owner?

MR. NEARY: Yes, sir; on both patents.

MR. GARRISON: Wait a minute until I get the date.

MR. NEARY: That is, the patent in suit and the application pending. We are not offering it with regard to the statements made concerning the patent pending, but with regard to the effect on the title to the patent in suit.

MR. GARRISON: If your Honor please, we were not incorporated at that time.

MR. NEARY: That is a quibble. The facts are these, if your Honor please, the title proven here is this: that Minerals Separation transferred the beneficial title to a corporation known as the 1913 Syndicate, and then in 1916, the 1913 Syndicate turned over all of its right, title and interest to the North American Corporation. So that, so far as that is concerned, the North American Corporation stands in a position of that 1913 corporation.

THE COURT: Do you agree, Judge Garrison, that the plaintiff was then a party in interest, the beneficial owner?

MR. GARRISON: I do not know the dates. I really think we would be better off if we got those dates before we attempted or your Honor ruled on this, and in my judgment it will conflict with the chronology; and I think we might postpone the argument.

THE COURT: I think it is important that we get it right.

MR. GARRISON: Let us get the chronology right, and then our side of the law can be offered.

MR. WILLIAMS: The title of this patent No. 1,099,699 does not appear in this document, but possibly there are things in evidence—

MR. NEARY: It appears that the application was transferred at the same time that the patent in suit was transferred.

MR. GARRISON: Mr. Neary, let us get the chronology and agree on it so that his Honor can have that before him:

THE COURT: You had better agree on that before I rule. Other than that, is there any other matter?

MR. GARRISON: Yes, I want to present one other.

MR. DAVIS: So do I. I find that we asked for certain information from the plaintiff under Rule No. 58, and they answered, and I think those answers ought to be put in evidence, and I offer them as an exhibit, and the answers to the interrogatories also.

Received in evidence and marked "Defendant's Ex. No. 141," Defendant's Interrogatories and Answers.

Received in evidence and marked "Defendant's Ex. No. 142," Defendant's Notice Under Equity Rule No. 58 and Answers.

MR. GARRISON: We are desirous of putting ourselves in such a position on this record that your Honor either will have admitted upon our request certain papers, pleadings and so forth, in the case of Minerals Separation, Limited, against Miami Copper Company, and Minerals Separation, Limited, against James M. Hyde, and Mineral Company, Limited, against the Butte and Superior Mining Company, for the purpose of thereby ascertaining what patents and documents claimed to be anticipations in those suits were before those courts deciding those suits, so as to intelligently understand their decisions, can properly apply, if they are properly to be applied; or if your Honor rules that offer out, we will have the benefit of having made the offer for what it is worth.

THE COURT: I will rule them out and you can have the benefit of the offer.

MR. GARRISON: For that purpose we wanted the defendants to agree to the stipulation that certain unofficial papers might be considered as those documents; and by unofficial papers I mean uncertified papers, but as I understand Mr. Davis, I have made the offer as if I have authenticated copies.

MR. DAVIS: Yes.

THE COURT: Yes.

MR. GARRISON: I now offer, if your Honor please, copies of the pleadings in the suit of Minerals Separation, Limited, against Miami Copper Company in the

United States District Court of the District of Delaware, and also copies of the Petition for leave to file Supplemental Bill in the nature of a Bill of Review, filed by the Miami Copper Company in the Circuit Court of Appeals for the Third Circuit, and the answer of the respondents filed by Minerals Separation, Limited, respondent: also a copy of the decision of that Court upon that motion, which decision is unreported, and we will naturally take the opportunity of giving your Honor a copy.

THE COURT: I should be glad to have the decision but I exclude it as evidence.

MR. GARRISON: I have not made my full offer yet. Also the pleadings in the suit of Minerals Separation, Limited, and others, against James M. Hyde, in the United States District Court for the District of Montana; and the pleadings in the suit of Minerals Separation, Limited, et al, against the Butte and Superior Mining Company in the United States District Court for the District of Montana. That is all. Now, I understand that your Honor says that you will exclude them.

THE COURT: By your offer you have apprised me of the importance and value of those papers in connection with the considering and interpreting the decisions of those courts, but as evidence in this case I exclude them.

MR. GARRISON: Then I may have an exception to that exclusion?

THE COURT: Certainly.

MR. GARRISON: And I presume I have the right under the Rule 46 that our opponents evoke to have them printed as part of this record, if I want to take them to the Circuit Court of Appeals?

THE COURT: Yes.

MR. GARRISON: That is all of the rights I can possibly have under the circumstances.

Marked "Plaintiff's Exhibit D for Identification"—Pleadings Minerals Separation, Limited, against Miami Copper Company.

Marked "Plaintiff's Exhibit E for Identification"—Petition for leave to file Supplemental Bill in the nature of a Bill of Review, Minerals Separation, Limited, against Miami Copper Company.

Marked "Plaintiff's Exhibit F for Identification"—File. Supplemental Bill in the nature of Bill of Review.

Marked "Plaintiff's Exhibit G for Identification"—Decision of Circuit Court of Appeals for Third Circuit, denying motion for leave to file Supplemental Bill in nature of Bill of Review.

Marked "Plaintiff's Exhibit H for Identification"—Pleadings, Mineral Separation, Limited, et al., against James M. Hyde.

Marked "Plaintiff's Exhibit I for Identification"—Pleadings, Minerals Separation, Limited, against Butte & Superior Copper Company.

MR. DAVIS: If your Honor please, I want to offer in evidence a certified copy of the file wrapper and contents of the United States Patent to Towne & Flinn, No. 1,295,817, that is, one of the patents under which the defendant is licensed.

(Received in evidence and marked "Defendant's Exhibit No. 143"—File wrapper and contents, Towne & Flinn Patent, No. 1,295,817.

MR. DAVIS: I also want to offer in evidence a certified copy of the file wrapper and contents of the United States Patent to Leslie Bradford, No. 1,101,506, which is the United States Patent corresponding to the Australian Patent, No. 632, of 1911, which Mr. Williams offered this morning.

MR. WILLIAMS: Upon what basis do you offer in evidence this file wrapper and contents of the United States Patent issued June 23, 1914?

MR. DAVIS: On the same basis, I imagine, that the Australian patent was offered. They both refer to the same subject matter, that is, the use of sulphuric acid as a mineral-frothing agent; and I suppose that Mr.

Williams offers the Australian patent which is dated in 1911, subsequent to anything here, of course—

MR. WILLIAMS: The Australian patent is offered as containing statements by Leslie Bradford, a witness for the defendant, put forth in a patent, and also as illustrating the one disclosure of the art wherein the inorganic substance, sulphuric acid, is used as a frothing agent. For that purpose this Australian patent was put in.

MR. DAVIS: If your Honor please, I object to its use for the purpose of showing any declarations by Mr. Bradford. He was here in this case and testified and cross-examined and the plaintiff had all the opportunity to examine him as to what statements he would make.

THE COURT: That is already in, without objections.

MR. DAVIS: Yes, but I was objecting to the use of it for any such purpose. Of course, that would be a matter that your Honor will pass upon, I suppose, anyway, when it is put forward for that purpose.

MR. WILLIAMS: It is offered for all purposes.

MR. DAVIS: It has no weight.

MR. WILLIAMS: I object to the offer in evidence of this certified file wrapper and contents of a United States patent, which was issued June 23, 1914, to Minerals Separation, Limited, a stranger to these proceedings, as the assignee of Leslie Bradford.

THE COURT: I do not see the materiality of that.

MR. DAVIS: That is a document—the patent is owned by the plaintiff, and it explains the things, or elaborates the things in this Australian patent that Mr. Williams has put in. If there is any relevancy in those things, there is equal relevancy in this.

THE COURT: Does that explain things in the Australian patent?

MR. NEARY: Yes, sir. It has relation to the same subject matter, the same patent, the same invention.

MR. WILLIAMS: It gives correspondence between Leslie Bradford, by his attorney, and the patent office

in the granting of this United States Patent, which is not itself in evidence. The oath, I believe, gives a reference—

MR. DAVIS: The oath acknowledges this Australian application on which the Australian patent was granted. It is the same invention.

THE COURT. If it has any bearing on your past evidence on the Australian patent, it ought to go in.

MR. WILLIAMS: I cannot see it has the slightest bearing upon this Australian patent. The thing it has bearing upon is a certain patent that was issued in this country in June 23, 1914, to Minerals Separation, Limited, as the assignee of Leslie Bradford, and that document is not in evidence at all.

MR. DAVIS: That document is part of this exhibit.

MR. WILLIAMS: You are trying to get that in.

THE COURT: That is offered as explanatory of this item called the Australian invention. If it is explanatory, I do not see why it is not properly in evidence.

MR. WILLIAMS: I cannot see how it can possibly be explanatory of the Australian patent.

THE COURT: I do not know it is offered for that purpose—I assumed it was.

MR. GARRISON: There is probably an African under this wood somewhere that we do not understand.

MR. WILLIAMS: It is explanatory of the United States Patent. The United States Patent is not in evidence.

MR. DAVIS: It will be when this gets in.

MR. WILLIAMS: This is an offer to introduce the United States Patent in evidence, accompanied by an explanation of it, this transaction which commences with the filing of the application in this country, and ends with the issuance of the patent here. That entire transaction is now to be put on the record for the first time. The defendant offers this document and says that it is offered in explanation of an entirely separate proceeding, to wit, the issuance of a patent in Australia on March 13, 1914.

THE COURT: I do not see much value in either of these pieces of evidence, as a matter of fact; this contradiction of Bradford is an indirect and improper way of contradicting him.

MR. NEARY: Your Honor understands that those papers relate to the same invention.

THE COURT: Well, I think I will take this position, let them both go in, not either.

MR. GARRISON: Well, your Honor will have to take this one physically out then, because that is in. We have that advantage at least.

MR. NEARY: They will both go in.

MR. GARRISON: I do not know how to do it, either have them both in or out, whichever your plan may be. I suggest that you look at that before you make up your mind. You will find an "African" in here somewhere, I know.

MR. WILLIAMS: I think we will decide now, if your Honor please, to withdraw both of them.

THE COURT: Very well, I thought that would be the result, take them both out.

(Plaintiff's Exhibit No. 21 withdrawn.)

THE COURT: There is no other oral evidence, is there, on either side?

MR. DAVIS: Yes, sir; just a moment; shall we go right on?

THE COURT: You are through?

MR. WILLIAMS: We are through, your Honor.

MR. GARRISON: Of course we reserve the right, if we find some document we have overlooked, to put them in.

THE COURT: Yes.

DEFENDANT'S PROOFS IN SUR-REBUTTAL.

ARTHUR FAY TAGGART, a witness on behalf of the defendant, was called in sur-rebuttal, and having been previously duly sworn, testified as follows:

DIRECT EXAMINATION.

By MR. DAVIS:

Q. 443. Professor Taggart, you saw the experiments carried on by Mr. Higgins at Boston, in the two little Gabbett mixers, on Saturday of last week?

A. Yes.

Q. 444. And you understood him to say that if he took the concentrate from the first Gabbett mixer, which had been formed by oleic acid, and filtered that concentrate and then put the material left on the filter back into the flotation apparatus of the Gabbett mixer, without any addition of oleic acid, that there would be substantial concentration?

A. Yes.

Q. 445. And you heard him say that if he took the similar concentrate that had been formed with phenol, filtered that, and took the material that was left on the filter, and put that back into an agitation machine without the addition of any further frothing agent, there would be no substantial recovery of mineral?

MR. WILLIAMS: If your Honor please, I certainly object to this as sur-rebuttal evidence. Here is a subject that was gone into in the defendant's case, and of course nothing has so far developed, except asking this witness whether or not he remembers something that is on the record, but it seems to me that we should know something of the purpose of this inquiry.

MR. GARRISON: Hadn't Mr. Davis better get those things they admitted Saturday? I think he has got them incorrect now.

THE COURT: That is a detail.

MR. GARRISON: I mean asking this witness if he remembers or don't remember is utterly immaterial. Mr.

Davis made certain concessions, and I think they ought to be correct in the minutes at the present time.

THE COURT: If this isn't any new thing brought out.

MR. GARRISON: My only point is that he is asking this witness whether he remembers something. Whether this witness remembers does not make any difference. What happened is on the record.

THE COURT: This is to bring out the matter further.

MR. GARRISON: I suggest in bringing up a matter he should do it correctly. He should do it from the record.

THE COURT: Of course he should. That is a detail again. Go ahead with your examination.

Q. 446. Did you answer that?

A. I have not answered it yet, but I will say yes.

Q. 447. Does that agree with your experience?

MR. GARRISON: Now, if your Honor please, we would like to raise this question.

MR. DAVIS: The answer is going to be yes, if that helps any.

MR. GARRISON: As long as they help us, we won't object, but we will object just as soon as you ask anything that we think is going too far afield.

MR. DAVIS: I am not trying to go back on what I conceded down there.

MR. GARRISON: I don't mean that, Mr. Davis.

A. Yes.

Q. 448. Does that indicate to you anything as to whether or not the particles of the mineral were coated with the agent of oleic acid or phenol?

MR. GARRISON: Now, if your Honor please, we think that is objectionable. They produced this witness as an expert and they have examined him fully on all this subject matter. We have produced our man and have examined him. If he goes on with this examination and we put our man back, it seems to me you can not go on forever contradicting each other. They do contradict each other. If he says this is not so, I think we ought to put our man back and find out which one can contradict the longest.

MR. DAVIS: I understood that we would be permitted to put on a witness about these experiments at Boston and which, of course, were to have been conducted, as we understood it, in the prima facie case. They were put off to the last minute. I supposed it was fully understood that if we wanted to we could put on our witness about what happened in Boston. I may say that this is the extent of it, I am not going beyond this one question—

MR. GARRISON: Before we take that up, just one minute. I do not want any misunderstanding. I understood that what Mr. Higgins did in Boston with this small machine was part of our traversing case and was not a part of our prima facie case at all. The exhibitions, which purported to be a replica of defendant's operations, were connected with our prima facie case. It was our understanding, of course, that whatever was connected with our prima facie, they should have an opportunity to meet, and I was surprised they did not take it when we came back from Boston, and I thought there was nothing they wanted to bring out. I did not think there would be anything to our traversing testimony, which has now been exhausted.

THE COURT: Strictly it has. I was wondering whether or not there was any misunderstanding as to when that should be brought out.

MR. DAVIS: The way I felt about it—I quite agree that it is sur-rebuttal—but the way I felt about it was that experiments of this sort always ought to be made inter-parties. The Courts look with disfavor upon ex-parte experiments, because they say if the other party was not invited to inspect them, it indicated that they were not inspectable.

Now, this test was made inter-parties, but was made at such a date that strictly, unless I can put on a witness to say what he saw, it is the equivalent of an ex-parte test. Not only that, but an ex-parte test at which your Honor was present, without having eyes present to say what we saw.

MR. GARRISON: If you say this ends it, I am willing that he answer that question, and consider it closed.

THE COURT: Is that as far as you will go?

MR. DAVIS: This is the only subject.

A. No.

MR. GARRISON: It did not indicate anything to you, I understand of that character?

THE WITNESS: As to whether the mineral particles were coated, no.

Q. 449. Why not?

MR. GARRISON: Now, if your Honor please—

THE COURT: I think he can finish it.

A. The test indicated nothing more than that in the case of oleic acid, all of the oleic acid had not gone into solution, while in the case of the phenol, all had gone into the solution. There is nothing particularly mysterious about this solution matter. It is just a question of the size of the particles into which the material that is added to the water is broken. If they are extremely small, so small that you can not see them, then it is solution. If they are larger, it is not solution. If they are so large that you can see them in there, it is not solution. In the case of the oleic acid we have particles there that are so fine that you can not see them and we have other particles up and up to a size big enough to have been seen, if we had had clear water. When they put that concentrate containing a lot of these particles of oleic acid that were not in solution onto the filter (which is just like a screen) those big particles of oleic acid would not go through the filter, and they were held back with the big particles of solid matter. Then, when that mixture was put back into the machine, those particles of oleic acid that had been held back went right ahead and functioned as they had in the first case, but they had not come off the mineral particles. They were there dispersed throughout the liquid. Now, when you put the phenol mixture on, the phenol particles were all dispersed so fine that they would go through the screen, so they went through. And there was still the phenol on the mineral particles, but as I testified before,

that phenol that was on the mineral particles is held there so tight that when the mineral particles with it on are put back in the water there is none of it that comes off into the water to cause the frothing, to cause the stabilization of the bubbles that is necessary for the production of froth.

MR. DAVIS: That is all.

MR. WILLIAMS: I will say to your Honor that I regret that we accepted the concession of defendant's counsel that the things would happen that Mr. Higgins said would happen, and did not go through the experiment so your Honor could have seen it with your own eyes.

THE COURT: Well, I do not need it, if that was the admission.

MR. WILLIAMS: But now the witness attacks the conclusions and expresses his opinions as to what would have happened if the procedure had been carried on.

THE COURT: No, he can not do it.

MR. WILLIAMS: But he has.

THE COURT: I shall accept the admission that the things would happen that Mr. Higgins said would happen.

MR. WILLIAMS: The witness says that if that had been done, certain other things would have happened, and I submit that that evidence of the witness is not based upon what was actually shown there, and therefore it should be stricken out.

THE COURT: Not wholly stricken out, perhaps?

MR. WILLIAMS: I mean in so far as the witness attempts to describe that would have happened in the thing that was not done.

THE COURT: So far as that is inconsistent with what Mr. Higgins said would happen, I shall not consider it. Now, I am not familiar with the details of the operation to distinguish, but in looking over the record I shall regard Mr. Davis' admission that the things would happen that Mr. Higgins said would happen as conclusive.

MR. DAVIS: If it will help any now, I will say that

that admission was made absolutely with no strings tied to it. The thing we are trying to prove by Professor Taggart is that that thing happening as it will happen undoubtedly, does not permit the deduction that Mr. Higgins made from it.

CROSS-EXAMINATION.

By MR. WILLIAMS:

XQ. 450. You are aware, are you not, Professor Taggart, that if you try to separate oleic acid from an emulsion of oleic acid by passing it through a filter paper, your filtrate will contain some oleic acid that has passed through in the form of an emulsion; you are aware of that, are you not?

A. What kind of a filter paper?

XQ. 451. Ordinary filter paper.

A. Absolutely. That is not the kind of material that I used in my test on the solubility of oleic acids.

XQ. 452. I am not asking you about your tests. We are confined to this subject.

A. Yes.

XQ. 453. Now, as I have understood what you said in answer to this question—and I may have misunderstood you—you said that if Mr. Higgins had taken the froth concentrate in the oleic acid test and put it on a piece of ordinary filter paper, that the oleic acid was in particles too big to go through that filter paper, and you would get a clear filtrate; is that the idea?

A. No, you would not get a clear filtrate for the first few seconds or for the first few units of solution that went through, but I suspect that the larger part of the filtrate would be clear, because, you see it is not the filter paper alone that acts as the material for filtering out oleic acid, but the filter paper with the solid material on it. The solid material is the really effective filtering medium. We really use the filter paper to hold the solid material on the filter, so that it may more effectively act as a sieve.

XQ. 454. As a matter of fact, the solid material on there is coated with oleic acid, is it not?

A. Without a doubt, and there are also globules of oleic acid.

XQ. 455. You mean that, in your opinion, there were globules of oleic acid on that filter paper not attached to the mineral particles; is that right?

A. As coatings?

XQ. 456. As coatings.

A. Yes, indeed.

XQ. 457. And that those globules did not go through the filter paper?

A. Yes, and were free, therefore, as free oleic acid in the machine when the concentrate was put back into the machine.

XQ. 458. And what is the basis of that?

A. I think if he had shaken that concentrate up, with some plain water, and then let it stand so as to give the globules of oleic acid a chance to collect and the solid particles to drop down, and let him see into the water, he would have seen oleic acid globules there.

XQ. 459. You think so?

A. I have done it. I did not do it with the particular material Mr. Higgins did, but I have done it in similar tests a considerable number of times.

XQ. 460. And what is it you say would happen, free oleic acid floating on the surface of the water?

A. And also dispersed through the water; also oleic acid in solution in the water.

XQ. 461. That, of course, is upon the theory of solution that you put forth before?

A. There is no theory about it. It is actual practical facts.

XQ. 462. Is it not a fact that if he shook that material you would get a froth, a mineral-bearing froth?

A. You would get some; you would not get very much.

XQ. 463. And would you distinguish the floating oil in that mineral-bearing froth?

A. Not a mineral-bearing froth, but you would have a little layer of froth on top, a layer of settled solids on the bottom, and in between a liquid material in which you could readily see the globules of oleic acid.

MR. WILLIAMS: With regard to this statement of the witness, your Honor, we deny emphatically that the thing that he says, occurs, and it is new matter injected in, and we would challenge the satement. I think perhaps the easiest way to do would be to have it contradicted by our witness, Mr. Higgins.

THE COURT: That is, this witness' interpretation you desire to deny?

MR. WILLIAMS: The last statement made by the witness, to wit: that if this had been subjected to a certain treatment there would have resulted froth in which you would have seen the globules of oleic acid.

THE WITNESS: I did not make any such statement as that, your Honor.

THE COURT: He said there would be a certain amount of froth.

THE WITNESS: Yes, sir, but I said distinctly that you would not see the oleic acid in the froth. I said there would be froth on top, settled solids, below, and in the middle between these two a zone of liquid not containing the solid, but containing dispersed globules of oleic acid, that could be seen.

THE COURT: That statement you desire to deny?

MR. WILLIAMS: You could see these dispersed globules of oleic acid in the clear space?

THE WITNESS: You could see the globules in that material, and if you put it under a microscope, you could very easily see those particles of liquid.

THE COURT: Of what?

THE WITNESS: Of liquid. You can distinguish them by shape from the solid particles, which would be jagged, and these liquid particles are round.

MR. WILLIAMS: We would like to have the opportunity of contradicting that statement.

THE COURT: I think in view of the fact that this is rather irregular, that you ought to have it.

MR. WILLIAMS: That is all.

MR. DAVIS: Before you do that, I would like to recall Mr. Yerxa. I want to prove one point by Mr. Yerxa, if your Honor please, which I recognize is sur-rebuttal. I ask leave to do it because the discussion came into the record in a rather peculiar way. Your Honor asked Mr. Higgins whether with any circuit containing one of these soluble agents you could continually repeat the operation, without supplying more agent. Mr. Higgins said that you could not, but that the loss was due to the sunlight. Then Mr. Chapman this morning testified that with oleic acid, in a closed circuit, if you stopped the flow of oleic acid, you would stop the formation of the froth and the concentration of the mill. I want to show by Mr. Yerxa that the same thing will happen if you stop the flow of one of these agents in solution, just that one subject.

MR. GARRISON: Is it not a fact that you had misunderstood what Mr. Higgins said?

MR. DAVIS: Unconsciously so, then.

MR. GARRISON: I know that, of course. I thought the Court asked him whether he could keep it up indefinitely, and he said the time would come when you could not, but he did not say it would not go on without the addition of a new frothing agent.

THE COURT: He said the loss was not due to the using up of the frothing agent, but to other causes.

MR. GARRISON: You are correct, but I do not think Mr. Davis has correctly stated that at the beginning of his statement.

THE COURT: Substantially so, I think.

MR. GARRISON: I understood him to say it would not concentrate without the addition of new material. That is exactly the opposite of what Mr. Higgins said.

MR. DAVIS: That is what I am going to prove.

MR. GARRISON: You ought not to prove it by misquoting Higgins.

THE COURT: The statement he made corresponds with what I understood Mr. Higgins to say. We understand that, I think. I think I will let you do that.

RALPH B. YERXA, recalled as a witness on behalf of the defendant in sur-rebuttal, having been previously duly sworn, further testified as follows:

DIRECT EXAMINATION.

By MR. DAVIS:

Q. 109. Mr. Yerxa, at the Miami plant, did you ever run the mill in closed circuit, that is, using all of the returned water that you had?

A. Yes.

Q. 110. And adding only sufficient fresh water to make up the loss by seepage, and so forth?

A. Yes.

Q. 111. And have you used in such a closed circuit an agent which exists in solution in the pulp?

A. Yes.

THE COURT: Are you going to show what it was?

MR. DAVIS: Yes, sir.

Q. 112. What was that agent, or were there more than one of them?

A. Why, in general, the agents used were creosote oils and pine oil.

Q. 113. And did you ever shut off the flow of the creosote oil or pine oil and observe what effect it would have upon the operation of the pneumatic cells?

A. Yes, many times.

Q. 114. What effect does it have?

A. The froth ceases to overflow the pneumatic cell, and consequently no concentration takes place.

CROSS-EXAMINATION.

By MR. WILLIAMS:

XQ. 115. I do not know that I quite understood you, Mr. Yerxa. Were you at this time using wholly returned circuit water; at any time when such a thing occurred were you using wholly returned circuit water?

A. Oh, yes; it was our general practice to use all of the returned circuit water that we had, if that is what you mean.

XQ. 116. What proportion of that returned circuit water to fresh water?

A. About seventy per cent of the total water in the circuit was reclaimed water; that is, water which had been through the system and returned to the mill.

XQ. 117. That is, it was seventy per cent returned circuit water and thirty per cent fresh water?

A. That is right.

XQ. 118. And the amount of mineral-frothing agent that you used in the mill in normal operations, was the minimum amount for the desired results, was it not, or the right amount for the desired results?

A. Yes, sir.

XQ. 119. You did not waste any?

A. No.

MR. WILLIAMS: That is all.

(Witness excused.)

THE COURT: That is the end of your oral testimony?

MR. DAVIS: Yes, sir.

THE COURT: You can recall Mr. Higgins if you want to.

MR. WILLIAMS: Yes, Mr. Higgins to the stand.

ARTHUR HOWARD HIGGINS, recalled, as a witness on behalf of the plaintiff, in sur-rebuttal, having been previously duly sworn, further testified as follows:

DIRECT EXAMINATION.

By MR. WILLIAMS:

Q. 796. Mr. Higgins, did you hear the testimony of Professor Taggart?

A. Yes, I did.

Q. 797. Did you hear the statement in that testimony that if you had taken the material that was held on the filter paper as the result of your experiment with the oleic acid last Saturday, and had put it in with a proper amount of water, and shaken it up, there would have formed upon settlement a froth on the surface of the liquid, and settled solids at the bottom of the liquid and in between the two, oleic acid in globules in the water? Did you hear that statement?

A. Yes, I understood Professor Taggart to say that.

Q. 798. What have you to say as to that statement, based upon your own experience?

A. In the first place, if the oleic acid had stayed in suspension in the water in that way, the percentage of it that would be entangled in the froth would only be a very small quantity, because of the fact that a very small amount of that original liquor is taken off in sliding the upper part of the machine. In the second place, on re-agitating that froth, the froth reforms to the extent of about ninety per cent, or even more than that reforms. If you destroy that froth by stirring it up with a spatula or something of that kind—it is a very lengthy proceeding—you are unable to see any globules of oleic acid whatever, as a result of such breaking down.

Q. 799. Suppose you allowed it to stand with the froth above, settled solids below and clear water in between—I think that was the particular instance?

A. I have never been able to see anything on allowing it to stand, except very minute particles of blende and some gangue.

Q. 800. That is to say, the slimes in the water?

A. Yes, I have very carefully examined the surface of

the water after such breaking down of froth and have never been able to find the slightest trace of any oil on the surface of such water. I have done it, both by surface tension tests, also by careful inspection with lens.

Q. 801. And when you break down froth, as you say, what do you do, sink it by breaking the bubbles?

A. Yes. It is a very lengthy proceeding.

Q. 802. So that all of the mineral goes to the bottom?

A. Yes.

Q. 803. And then you say under those conditions, you have no free oil on the surface at all?

A. Yes, I have wiped the surface clean with a piece of paper, so as to remove any little froth that was left to one side, and then tested that with camphor. If there is any trace of oil on that surface, a speck of camphor will show immediately whether there is any oil or not. On putting on the piece of camphor to a clean water surface, or a surface that does not contain any oil, the camphor spins around, moves about in lively movements. If there is a trace of oil there that you cannot see—that trace is generally accepted as being something about one molecule thick—the camphor movements are immediately stopped, and in the tests I have made to find out what happened to oleic acid, and in examining the surface that I have described by scraping the little residue of froth, or the few bits of scum aside and then treating the surface with camphor, I find, that the lively movement of camphor continues in the same fashion as it does on water, proving that there is no free oleic acid there.

CROSS-EXAMINATION.

By MR. DAVIS:

XQ. 804. As I understand it, you say these tests prove that there is oleic acid present on the mineral particles of the concentrate?

A. That is my deduction. The oleic acid is found associated with the mineral particles. It can be removed from them by washing with suitable solvents, such as alcohol, and there is an absence of any substantial quantity of oleic acid

with the gangue—there may be a few per cent—and no trace of free oil can be discovered.

XQ. 805. I understood you to say in direct examination that there was some oleic acid entrapped in the froth that goes over with the concentrates.

A. No, I did not say that; I did not intend to give that impression. I am convinced that it could be seen, if there was free oleic acid such as Professor Taggart states that he has seen. I am convinced that that could be seen by taking the froth and examining it under a microscope. I have done this several times and have never seen any globules of oleic acid.

XQ. 806. But you said under the heading "in the first place," in answer to the first question of Mr. Williams on the subject, that in the first place the amounts of oleic acid entrapped in the froth were very small. That is what I meant when I say you admit there was some there.

A. No, I say if there was free oleic acid floating about in that fashion, that it should be distributed all through the pulp. Professor Taggart said it was in such a fine state that you could not see it with the naked eye. That means to say it is extremely finely divided, and that it would spread itself out in the whole pulp. I was assuming Professor Taggart's hypothesis to be correct. Under such assumption I only take off about 200 or 300 cc. of water out of that pulp in using 1800 altogether. You see, that is a very small proportion that would be taken off. That proportion should be, if Professor Taggart is correct, the same ratio as the proportion of water I take off to the proportion I leave behind; that is two parts out of eighteen.

XQ. 807. Do you agree with the idea that this process of flotation requires two things, first, that the mineral particle shall be coated? I am talking about the flotation with oleic acid now, and second, that there shall be some froth-forming substance in the water?

A. Yes, in this case they are both one and the same, oleic acid.

XQ. 808. That is, oleic acid here in this re-frothing operation acts both as the modifying agent to make the froth on the water, and as the coating agent on the minerals to attach the air particles thereto?

A. Yes.

(Witness excused.)

MR. GARRISON: If your Honor please, before we adjourn for the day, how much time is your Honor going to devote tomorrow to the argument?

THE COURT: As much time as you desire, practically.

MR. GARRISON: I assume that it will be fair to divide that between the two sides.

THE COURT: Oh, yes.

MR. GARRISON: And I assume you have no objection to how many counsel speak on each side.

THE COURT: None at all. I want to hear what everybody thinks is pertinent to the issue.

MR. WILLIAMS: I take it, therefore, we may have the privilege of opening and closing. That is the custom, is it not?

THE COURT: What is your practice about that? You have had more experience about that than I have. What is your practice in these cases?

MR. WILLIAMS: I have never argued a patent case in equity in any other way than with the plaintiff opening and closing.

MR. DAVIS: I think you will all agree with this—I am sure Mr. Kenyon will—that the Courts in these patent cases insist in the oral arguments on a full opening. I assume your Honor will do the same.

MR. GARRISON: Before we know what you are going to insist on?

MR. DAVIS: Yes.

MR. GARRISON: I do not see how we can. It is just a waste of time.

MR. DAVIS: We ought to have a chance to answer, of course. I was going to say that actually in practice —and I think all of these gentlemen will agree with this —we are never shut off. We are permitted to make an answer on subjects that seem to be new, but I think that we are entitled to a full opening of this case by the plaintiff in the argument.

THE COURT: Well, if you do not get it, why, you can have a chance to answer anything further that you want.

MR. DAVIS: That is satisfactory to me. I think it is much more orderly and more profitable all around if their case is fully stated and let me state mine.

THE COURT: I will leave that to them, with the understanding that you have the opportunity. How much time do you want each? Start with a definite time.

MR. DAVIS: Ten o'clock we start; that is five hours and a half if we take the whole day.

MR. GARRISON: Let us take five hours as a basis. How long will that give as the basis for each side?

MR. DAVIS: Two and one-half hours.

MR. GARRISON: We will take two and one-half. Of course, we will take more if we want it.

THE COURT: That will be enough.

MR. DAVIS: You won't shut us off?

THE COURT: Oh, no.

MR. GARRISON: Some of us want to take the five o'clock train. That is the difficulty.

MR. DAVIS: If you finish in two hours, I will too.

MR. GARRISON: All right.

STIPULATION

IT IS HEREBY STIPULATED AND AGREED by and between counsel for the parties hereto that the following facts appear from the testimony given in the suits referred to in plaintiff's answers to defendant's interrogatories and that the

witnesses who testified as to those facts, respectively, would, if called as witnesses in the instant case, so testify again.

And it is Further Stipulated and Agreed that these facts are to be made a part of the record of the instant case with the same force and effect as if adduced by oral testimony at the trial.

Minerals Separation, Limited, was registered (that is, organized under the laws of Great Britain) about December 31, 1903, and was an outgrowth or development of the Cattermole Ore Concentration Syndicate, registered in Great Britain in September, 1903. The Australian Ore Concentration Syndicate was an earlier concern in which John Ballot was interested.

The Board (of Directors) of Minerals Separation, Limited, consisted (in 1908) of John Ballot, Dr. Seth Gregory, Mr. J. H. Curle, Mr. W. W. Webster, Mr. Francis L. Gibbs and Mr. A. H. Krohn. With the exception of Mr. Francis Gibbs (who joined the Board about a year later) all of these gentlemen were Directors of Minerals Separation, Limited, from the date of registration of Minerals Separation, Limited, December 31, 1903. During 1903 Mr. Webster, Dr. Gregory and Mr. Curle were interested with Mr. Ballot in the Cattermole Syndicate and were also interested in the investigation of the Cattermole process which was taken up early in 1903.

The shares of Minerals Separation, Limited, as incorporated on December 31, 1903, were distributed as follows: Gregory received 1750 shares, Courtney received 1458 shares, The Kew Consolidated received 1450 shares, James Hay received 875 shares, Webster received 875 shares, Ballot received 1167 shares, Curle received 584 shares, Govett received 583 shares, Sulman & Picard received 1350 shares and Cattermole received 900 shares.

John Ballot was a director of the Australian Ore Concentration Syndicate and of the Cattermole Ore Concentration Syndicate. From the date of its registration and until about 1917, John Ballot was Chairman and Managing Direc-

tor of Minerals Separation, Limited. Thereafter, he remained a director until the time of his death, April 1, 1922.

The firm of Sulman & Picard, consisting of Henry Livingstone Sulman and Hugh Fitzalis Kirkpatrick Picard, were retained as consulting metallurgical engineers by the Australian Ore Concentration Syndicate and by the Cattermole Ore Concentration Syndicate. From the date of registration of Minerals Separation, Limited, until the present time, said Sulman & Picard have continuously been retained by Minerals Separation, Limited, as consulting engineers.

Arthur Howard Higgins entered the employ of Sulman & Picard in the latter part of December, 1903, and for a period of about six months thereafter, and after the registration of Minerals Separation, Limited, was engaged upon that company's work entirely, and then entered the employ of Minerals Separation, Limited, and continued in that employ until about December 7, 1916, when the plaintiff company was incorporated.

Arthur Edward Cattermole was a stockholder in the Cattermole Ore Concentration Syndicate from the time of its organization. His shares of stock in that Syndicate were exchanged for shares of stock in Minerals Separation, Limited.

George Albert Chapman was employed by Sulman & Picard about September, 1899, and continued in that employment until about April, 1904, when he entered the employ of Minerals Separation, Limited, and continued in that employment until February or March, 1913, when he entered the employment of Minerals Separation American Syndicate (1913) Limited, and continued in that employment until about December 7, 1916, when the plaintiff company was incorporated.

John Ballot purchased the British patent to Froment, No. 12,778, of 1902, on or about November 17, 1903, acting for and on behalf of the group of individuals who had acquired the Cattermole patents and also some Sulman & Picard patents, all of which patents were taken over by Minerals Sepa-

ration, Limited, as soon as that company was formed. The actual assignment of the Froment British patent, 12,778, of 1902, by John Ballot to Minerals Separation, Limited, was made on or about August 15, 1906.

Mr. Ballot personally negotiated the purchase of Mr. Froment's patent with him in Italy, at Turin, and while there asked Mr. Froment to give him all possible information and also to send him plans and drawings, together with clear and definite instructions, as well as to have a model plant built and shipped to England for the purpose of carrying out the Froment process as Mr. Froment recommended it should be done. This Mr. Froment promised to do, with the result that towards the end of the year (1903) the plans and instructions were received, and some time early in 1904 the said plant itself was received in London.

Defendant's Exhibit No. 118 (entitled "Froment Description," "Froment Plant" and Froment Drawing-A") are correct copies of the instructions, plans and drawings so received in 1903 from Mr. Froment, and the translation forming part of said exhibit is a correct translation of the Froment description and the descriptive matter on the Froment drawings.

It is further stipulated by and between counsel for the parties hereto that the following facts be made a part of the record of the instant case with the same force and effect as if duly proven by oral testimony at the trial:

On or about May 3, 1907, Minerals Separation, Limited, instituted suit against the Ore Concentration Co. (1905), Limited, for infringement of the Froment British Patent, No. 12,778, of 1902. The defendant's process alleged to be infringing in this action was the process described in the British patent of Elmore, No. 17,816, of 1904.

Defendant's Exhibit No. 119 is a correct copy of the statement of claim, particulars of breaches, defense, particulars of objections, and notice of discontinuance in the matter of that suit.

Minerals Separation, Limited, maintained the Froment British Patent, No, 12,778, of 1902, in force for the full term for which the patent was granted by payment of the annual renewal fees required by law.

Defendant's exhibit No. 120 is a correct copy of the following (15) reports or documents, lettered "a" to "o", inclusive:

(a) Sulman & Picard to John Ballot, dated March 25, 1903.

(b) Sulman & Picard to John Ballot, dated May 5, 1903.

(c) Sulman & Picard to John Ballot, dated September 24, 1903.

(d) Sulman & Picard to John Ballot, dated November 19, 1903.

(e) Sulman & Picard to John Ballot, dated March 4, 1904.

(f) Sulman & Picard to John Ballot, dated April 19, 1904.

(g) Sulman & Picard to John Ballot, dated May 2, 1904.

(h) Sulman & Picard to Messrs. The Mineral Separation, Ltd., dated May 18, 1904.

(i) Sulman & Picard to Messrs. Minerals Separation, Ltd., dated February 17, 1905.

(j) Sulman & Picard to John Ballot, dated February 21, 1905.

(k) The report of A. Howard Higgins of March 2, 1905.

(l) Sulman & Picard to John Ballot, dated March 3, 1905.

(m) The report of A. Howard Higgins, of March 16, 1905, entitled "Further Report on Conditions of Granulation, March 16, 1905. Influence of the Percentage of Oil."

(n) Sulman & Picard to John Ballot, dated May 3, 1905.

(o) The report or paper addressed to "The Board of Directors, Minerals Separation, Limited" dated December 3, 1910, by Edward H. Nutter.

Arthur Howard Higgins left England for Australia in August, 1908, and was thereafter in Australia until about the 10th of March, 1909, when he left Australia and returned to England.

Henry Livingstone Sulman was not in Australia at any time during 1908 or 1909.

The British Ore Concentration Syndicate, on February 20, 1907, commenced an action against Minerals Separation, Limited, for infringement of Elmore British Patents, Nos. 21,948, of 1898, and 6519, of 1901. Mr. Justice Neville's decision thereon appears in Reports of Patent, Design and Trade-Mark Cases, October 21, 1908, pages 741-756.

In the Appellate Court Mr. Justice Fletcher Moulton rendered the decision of the Court December 2, 1908. This decision appears in Reports of Patent, Design and Trade Mark Cases, February 24, 1909, Vol. XXVI, page 124.

An appeal was taken by the defendants from the decision of the Court of Appeals to the House of Lords, and this appellate tribunal, on or about November 16, 1909, reversed the decision of the Court of Appeals. The decision of the House of Lords appears in The Illustrated Official Journal (Patents), Supplement, January 26, 1910, pages 33 to 54.

It is further stipulated by and between counsel for the parties hereto that SETH GREGORY, if called as a witness, would testify as follows:

That he is now and has been the president of the plaintiff, Minerals Separation North American Corporation, since June, 1922. That from the time of incorporation of the plaintiff company, on or about December 7, 1916, and until June, 1922, he was vice-president of the plaintiff company.

That he was a director of Minerals Separation, Limited, from the time of its registration, on or about December 31, 1903, until August, 1922, and that he is not now an officer, director or stockholder of Minerals Separation, Limited.

That he is the same Seth Gregory mentioned in the power of attorney given John Ballot by Minerals Separation Ameri-

can Syndicate (1913), Limited, which power of attorney was recorded on or about June 15, 1917, in the transfers of patents of the United States Patent Office, Liber J-102, page 469, and the Defendant's Exhibit No. 121 is, to the best of his knowledge, information and belief, a correct copy of said power of attorney.

That Defendant's Exhibit No. 122 is, to the best of his knowledge, information and belief, a true and correct copy of the following documents:

(a) Statement in lieu of prospectus filed by Minerals Separation American Syndicate (1913), Limited.
(b) Return of allotments from the 1st of July, 1913, to the 23rd of July, 1913, of Minerals Separation American Syndicate (1913), Limited.
(c) Extract from annual return of Minerals Separation American Syndicate (1913), Limited, made up to the 26th day of November, 1914.

That Defendant's Exhibit No. 123 is a true and correct copy of the plaintiff's, Minerals Separation North American Corporation, standard form of license agreement as used by said plaintiff in granting licenses in the United States of America under the letters patents enumerated in said agreement.

That Henry Howard Greenway was from November 1907 and until July of 1909 in the employ of Minerals Separation, Limited, and was, during this period, located in London, England, where he was engaged in looking after the metallurgical part of the litigation of the company.

Edward H. Nutter was during 1910 employed by Minerals Separation, Limited, as an engineer.

It is Further Stipulated by and between counsel for the parties hereto that the following facts be made a part of the record of the instant case with the same force and effect as if duly proven by oral testimony at the trial.

As a result of meetings and correspondence with Henry Livingstone Sulman, Arthur Edward Cattermole, in the win-

ter of 1902-1903, went to Mr. Sulman's laboratory to carry out further experiments on the Cattermole granulation process. Mr. Cattermole had a sort of exposition of the whole process (Cattermole granulation process) written up in a notebook, a resumé of all of his old notebooks, and this notebook he handed afterwards to Mr. John Ballot. The notebook shows the laboratory use by Mr. Cattermole of the following agents for coating mineral particles in carrying out the Cattermole granulation process—Oleic Acid, Stearic Acid, Oleates, Stearates, Light Lubricating Oils, Residuum (American dark summer), Heavy Hydrocarbon Oils, Jeyes Fluid (Sodium Cresylate), Paraffin Oil, Asphalt, Pitch, some Animal and Vegetable Oils, Linseed Oil, Rape Oil, Resin, Resin Oil, Stockholm Tar, Anthracene Oil, Green Oil, Coal Tar.

Whereupon, at 1 o'clock, P. M., an adjournment was taken until tomorrow morning, Friday, July 6, 1923, at 10:00 o'clock.

The following were received in evidence and marked:

"Plaintiff's Ex. No. 32"—Hoover 152 for Identification—Article in Engineering & Mining Journal of April 30, 1910, entitled "Oil Flotation Process at Broken Hill, N. S. W.," by Theodore J. Hoover.

"Plaintiff's Ex. No. 33"—Hoover No. 153 for Identification—Telegram to J. F. Neary from T. J. Hoover, August 30, 1919.

"Plaintiff's Ex. No. 34"—Hoover No. 154 for Identification—Letter from Miami Copper Company to T. J. Hoover, September 19, 1919.

"Plaintiff's Ex. No. 35"—Hoover No. 155 for Identification—Telegram from J. E. Neary to T. J. Hoover, September 19, 1919.

"Plaintiff's Ex. No. 36"—Hoover No. 156 for Identification—Letter from T. J. Hoover to Miami Copper Company, September 15, 1919.

"Plaintiff's Ex. No. 37"—Hoover No. 157 for Identification—Telegram from J. F. Neary to T. J. Hoover, October 2, 1919.

"Plaintiff's Ex. No. 38"—Hoover No. 158 for Identification—Opinion of George Gray and H. H. Ward to J. F. Neary, November 11, 1919 (also Defendant's Exhibit No. 91).

Plaintiff's Ex. No. 39"—Hoover No. 159 for Identification—Letter from T. J. Hoover to J. F. Neary, dated October 16, 1919.

"Plaintiff's Ex. No. 40"—Hoover No. 160 for Identification—Telegram from J. F. Neary to T. J. Hoover, December 12, 1919.

"Plaintiff's Ex. No. 41"—Hoover No. 161 for Identification—Letter from J. F. Neary to T. J. Hoover, December 5, 1919.

"Plaintiff's Ex. No. 42"—Hoover No. 162 for Identification—Letter from T. J. Hoover to J. F. Neary, September 5, 1919.

"Plaintiff's Ex. No. 43"—Hoover No. 163 for Identification—Letter from Allen H. Rogers to T. J. Hoover, February 10, 1920.

"Plaintiff's Ex. No. 44"—Hoover No. 164 for Identification—Letter from H. H. Knox to T. J. Hoover, February 13, 1920.

"Plaintiff's Ex. No. 45"—Hoover No. 165 for Identification—Letter from W. R. Ingalls to T. J. Hoover, February 17, 1920.

"Plaintiff's Ex. No. 46"—Hoover No. 166 for Identification—Letter from T. J. Hoover to Miami Copper Company, April 1, 1920.

"Plaintiff's Ex. No. 47"—Hoover No. 167 for Identification—Affidavits of T. J. Hoover in suit of Minerals Separation, Limited, against Miami Copper Company in Circuit Court of Appeals, Third Circuit.

"Plaintiff's Ex. No. 48"—Hoover No. 168 for Identification—Letter from T. J. Hoover to J. F. Neary, May 13, 1920.

"Plaintiff's Ex. No. 49"—Hoover No. 169 for Identification—Letter from J. F. Neary to T. J. Hoover, May 19, 1920.

"Plaintiff's Ex. No. 50"—Hoover No. 170 for Identification—Letter from J. F. Neary to T. J. Hoover, May 25, 1920.

"Plaintiff's Ex. No. 51"—Hoover No. 171 for Identification—Letter from T. J. Hoover to J. F. Neary, June 8, 1920.

"Plaintiff's Ex. No. 52"—Hoover No. 172 for Identification—Letter from J. F. Neary to T. J. Hoover, June 25, 1920.

"Plaintiff's Ex. No. 53"—Hoover No. 173 for Identification—Letter from J. F. Neary to T. J. Hoover, August 25, 1920.

"Plaintiff's Ex. No. 54"—Hoover No. 174 for Identification—Letter from T. J. Hoover to J. F. Neary, September 30, 1920.

"Plaintiff's Ex. No. 55"—Hoover No. 175 for Identification—Letter from J. F. Neary to T. J. Hoover, December 23, 1920.

"Plaintiff's Ex. No. 56"—Hoover No. 176 for Identification—Letter from T. J. Hoover to J. F. Neary, January 17, 1921.

"Plaintiff's Ex. No. 57"—Hoover No. 177 for Identification—Telegram from J. F. Neary to T. J. Hoover, February 5, 1920.

"Plaintiff's Ex. No. 58"—Hoover No. 178 for Identification—Telegram from J. F. Neary to T. J. Hoover, February 16, 1920.

"Plaintiff's Ex. No. 59"—Hoover No. 179 for Identification—Telegram from T. J. Hoover to John Agnew, February 17, 1920.

"Plaintiff's Ex. No. 60"—Hoover No. 180 for Identification—Telegram from J. F. Neary to T. J. Hoover, March 31, 1920.

"Plaintiff's Ex. No. 61"—Hoover No. 181 for Identification—Letter from T. J. Hoover to Miami Copper Company, April, 1920.

"Plaintiff's Ex. No. 62"—Hoover No. 182 for Identification—Telegram from J. F. Neary to T. J. Hoover, April 3, 1920.

"Plaintiff's Ex. No. 63"—Hoover No. 183 for Identification—Telegram from J. F. Neary to T. J. Hoover, April 5, 1920.

"Plaintiff's Ex. No. 64"—Hoover No. 184 for Identification—Letter from J. F. Neary to T. J. Hoover, January 26, 1921.

"Plaintiff's Ex. No. 65"—Hoover No. 185 for Identification—Letter from T. J. Hoover to J. F. Neary, February 28, 1921.

"Plaintiff's Ex. No. 66"—Hoover No. 186 for Identification—Letter from J. F. Neary to T. J. Hoover, April 11, 1921.

"Plaintiff's Ex. No. 67"—Hoover No. 187 for Identification—Letter from J. F. Neary to T. J. Hoover, January 19, 1921.

"Plaintiff's Ex. No. 68"—Hoover No. 188 for Identification—Telegram from T. J. Hoover to J. F. Neary, December 6, 1921.

"Plaintiff's Ex. No. 69"—Hoover No. 189 for Identification—Letter from W. R. Ingalls to T. J. Hoover, February 19, 1920.

"Plaintiff's Ex. No. 70"—Hoover No. 190 for Identification—Letter from J. F. Neary to T. J. Hoover, February 16, 1921.

"Plaintiff's Ex. No. 71"—Hoover No. 191 for Identification—Telegram from T. J. Hoover to J. F. Neary, May 13, 1920.

"Plaintiff's Ex. No. 72"—Hoover No. 192 for Identification—Telegram from T. J. Hoover to J. F. Neary, May 15, 1920.

"Plaintiff's Ex. No. 73"—Hoover No. 193 for Identification—Telegram from T. J. Hoover to J. F. Neary, June 18, 1920.

"Plaintiff's Ex. No. 74"—Hoover No. 194 for Identification—Telegram from J. F. Neary to T. J. Hoover, December 2, 1921.

"Plaintiff's Ex. No. 75"—Hoover No. 195 for Identification—Telegram from T. J. Hoover to J. F. Neary, December 3, 1921.

"Plaintiff's Ex. No. 76"—Hoover No. 196 for Identification—Telegram from J. F. Neary to T. J. Hoover, December 5, 1921.

"Plaintiff's Ex. No. 77"—Hoover No. 197 for Identification—Letter from J. F. Neary to T. J. Hoover, March 7, 1921.

"Plaintiff's Ex. No. 78"—Hoover No. 198 for Identification—Telegram from T. J. Hoover to J. F. Neary, February 17, 1920.

"Plaintiff's Ex. No. 79"—Hoover No. 199 for Identification—Telegram from J. F. Neary to T. J. Hoover, January 22, 1920.

"Plaintiff's Ex. No. 80"—Hoover No. 200 for Identification—Telegram from T. J. Hoover to J. F. Neary, January 23, 1920.

"Plaintiff's Ex. No. 81"—Hoover No. 201 for Identification—Letter from T. J. Hoover per J. F. Neary to W. R. Ingalls, H. H. Knox and A. W. Rogers, February 9, 1920.

"Plaintiff's Ex. No. 82"—Hoover No. 202 for Identification—Cover of Hoover Australian Diary.

"Plaintiff's Ex. No. 83"—Hoover No. 202-A, 202-B, 202-C, 202-D and 202-E for Identification—Extracts from Hoover's Australian Diary.

"Plaintiff's Ex. No. 84"—Hoover No. 203 for Identification—Letter from T. J. Hoover to John Ballot, October 10, 1910.

"Plaintiff's Ex. No. 85"—Hoover No. 204 for Identification—Letter from John Ballot to T. J. Hoover, October 11, 1910.

"Plaintiff's Ex. No. 86"—Hoover No. 205 for Identification—Letter from T. J. Hoover to Directors of Minerals Separation, Limited, November 29, 1910.

"Plaintiff's Ex. No. 87"—Hoover No. 206 for Identification—Letter form T. J. Hoover to Directors of Minerals Separation, Limited, December 8, 1910.

"Plaintiff's Ex. No. 88"—Hoover No. 207 for Identification—Letter from T. J. Hoover to John Ballot, January 2, 1911; and Hoover No. 207-A for Identification—Minute for proposed contract for services.

"Plaintiff's Ex. No. 89"—Hoover No. 208 for Identification—Letter from John Ballot to T. J. Hoover, January 3, 1911.

"Plaintiff's Ex. No. 90"—Hoover No. 209 for Identification—Letter from T. J. Hoover to John Ballot, February 6, 1911.

"Plaintiff's Ex. No. 91"—Hoover No. 210 for Identification—Letter from John Ballot to T. J. Hoover, January 6, 1911.

"Plaintiff's Ex. No. 92"—Hoover No. 211 for Identification—Letter from John Ballot to T. J. Hoover, January 10, 1911.

"Plaintiff's Ex. No. 93"—Hoover No. 212 for Identification—Letter from T. J. Hoover to John Ballot, January 11, 1911.

"Plaintiff's Ex. No. 94"—Hoover No. 213 for Identification—Letter from T. J. Hoover to Minerals Separation, Limited, January 12, 1911.

"Plaintiff's Ex. No. 95"—Hoover No. 214 for Identification—Letter from John Ballot to T. J. Hoover, January 12, 1911.

"Plaintiff's Ex. No. 96"—Hoover No. 215 for Identification—Letter from T. J. Hoover to John Ballot, January 12, 1911.

"Plaintiff's Ex. No. 97"—Hoover No. 216 for Identification—Letter from A. C. Williams, Secretary, to T. J. Hoover, January 13, 1911.

"Plaintiff's Ex. No. 98"—Hoover No. 217 for Identification—Book entitled "Concentrating Ores by Flotation" by T. J. Hoover (first edition), 1912.

"Plaintiff's Ex. No. 98-A"—Hoover No. 217-A for Identification—Extract in preface, Exhibit 98.

"Plaintiff's Ex. No. 98-B"—Hoover No. 217-B for Identification—Extract pages 8 and 9.

"Plaintiff's Ex. No. 98-C"—Hoover No. 217-C for Identification—Extract page 11.

"Plaintiff's Ex. No. 98-D"—Hoover No. 217-E for Identification—Extract page 14.

"Plaintiff's Ex. No. 98-E"—Hoover No. 217-F for Identification—Extract page 16.

"Plaintiff's Ex. No. 98-F"—Hoover No. 217-G for Identification—Extract page 16.

"Plaintiff's Ex. No. 98-G"—Hoover No. 217-H for Identification—Extract page 25.

"Plaintiff's Ex. No. 98-H"—Hoover No. 217-I for Identification—Extract page 30.

"Plaintiff's Ex. No. 98-I"—Hoover No. 217-J for Identification—Extract page 59.

"Plaintiff's Ex. No. 98-J"—Hoover No. 217-K for Identification—Extract page 85.

"Plaintiff's Ex. No. 98-K"—Hoover No. 217-L for Identification—Extract page 89.

"Plaintiff's Ex. No. 98-L"—Hoover No. 217-M for Identification—Extract page 92.

"Plaintiff's Ex. No. 98-M"—Hoover No. 217-N for Identification—Extract page 92.

"Plaintiff's Ex. No. 98-N"—Hoover No. 217-O for Identification—Extract page 95.

"Plaintiff's Ex. No. 98-O"—Hoover No. 217-P for Identification—Extract page 96.

"Plaintiff's Ex. No. 98-P"—Hoover No. 217-Q for Identification—Extract pages 119 and 120.

"Plaintiff's Ex. No. 98-Q"—Hoover No. 217-R for Identification—Extract page 124.

"Plaintiff's Ex. No. 98-R"—Hoover No. 217-S for Identification—Extract page 129.

"Plaintiff's Ex. No. 98-S"—Hoover No. 217-T for Identification—Extract pages 158 and 159.

"Plaintiff's Ex. No. 99"—Hoover No. 218 for Identification—Title Sheet of Directors' Report of the Zinc Corporation, Limited, and page 19 thereof.

"Plaintiff's Ex. No. 100"—Hoover No. 219 for Identification—Book entitled "Concentrating Ores by Flotation" by T. J. Hoover, Second Edition, 1914.

"Plaintiff's Ex. No. 100-A"—Hoover No. 219A for Identification—Extract pages 53 to 56.

"Plaintiff's Ex. No. 100-B"—Hoover No. 219-B for Identification—Extract pages 56 to 66.

"Plaintiff's Ex. No. 100-C"—Hoover No. 219-C for Identification—Extract page 192.

"Plaintiff's Ex. No. 101"—Hoover No. 220 for Identification—Book entitled "Concentrating Ores by Flotation," by T. J. Hoover, Third Edition,, 1916.

TENTH DAY

TRIAL RESUMED

Bangor, Me., July 6, 1923,
10:00 o'clock a. m.

Met pursuant to adjournment.

Parties present as before.

MR. WILLIAMS: I offer in evidence a copy of patent to E. R. Gabbett, No. 44,345, of January 6, 1891, which was referred to in the cross-examination of Professor Taggart.

(Received in evidence and marked "Plaintiffs' Exhibit No. 111.")

MR. GARRISON: If your Honor please, yesterday the defendant offered in evidence the so-called Greenway application. We objected to it, and at my suggestion the matter was laid over until this morning, because I was uncertain as to the dates, and I wished to secure the dates as the basis of my objection. I find that the patent in suit was issued June 28, 1910. The beneficial interest therein was assigned to Minerals Separation American Syndicate (1913), Limited, in July, 1913. This beneficial interest was purchased from Minerals Separation American Syndicate (1913), Limited, on December 7, 1916, by the present plaintiff, Minerals Separation North American Corporation. The legal title was assigned to

Minerals Separation, Limited, on August 26, 1910, and passed to the present plaintiff on June 1, 1922.

The Greenway application was assigned to Minerals Separation, Limited, on May 12, 1911, and the assignment of the beneficial interest and the final vesting of the title were similar to that with respect to the patent in suit. The affidavits of Greenway and Ballot contained in this file which the defendant seeks to have the right to take advantage of are dated the 13th day of February, 1914. The basis of my objection is so well stated by Mr. Justice Blatchford, of the Supreme Court, that I will content myself with reading a citation from the case of *Masury against Anderson*, 16 Fed. Cas. 1087, 1088; 1 Blatchford, 162:

> "The rights of the plaintiff depend upon the claim in his patent, according to its proper construction, and not upon what he may erroneously suppose it covers. If at one time he insists on too much, and at another on too little, he does not thereby work any prejudice to the rights actually secured to him."

Our proposition is that nothing that Greenway and Ballot said on the 13th of February, 1914, could alter the situation as it existed on the 28th of June, 1910, when our contract with the government for this patent was completed.

MR. NEARY: My position, as I stated clearly yesterday, and as appears by the dates Judge Garrison has read, is that at the time the statements were made, the legal title to this patent in suit, as well as of the application concerning which the proceedings were being had, was in Minerals Separation, Limited. The beneficial interest was in the predecessor of the present plaintiff. The statements were made by John Ballot and Greenway, acting as agents for the holder of the legal title. My position is that statements made concerning the title to the subject matter of this suit are statements made that in

some way affect the subject matter of this suit, and that are inconsistent with the present position taken in this case with regard to the subject matter of this suit, and as such are admissible as inconsistent statements, not as conclusive, but merely as statements which should be received by the Court.

THE COURT: The position is not taken by the same people who made the statement.

MR. NEARY: I think that the law is this, if your Honor please, that statements made by privies in title, while holding title, bind their successors in title. These statements were made by Minerals Separation, Limited, and a predecessor in title, as the privies in title to the present plaintiff, Mineral Separation North American Corporation, while holding the title, and as such those statements are receivable in evidence in opposition to or in contravention of the position which is now being taken by the present holder of the title.

Now, I have innumerable cases on that subject if your Honor is in doubt on it.

THE COURT: On the general proposition I have no doubt.

MR. GARRISON: If your Honor please, he is talking with regard to the terms of an estoppel. We have no relations by which he can say we are estopped.

MR. NEARY: It is not a question of estoppel at all. It is a definite principle which allows admissions made by privies in title, while holding the title, to be introduced in evidence against their successors in title. There cannot be any question about that law, and the case which Judge Garrison read does not in any way touch on this question, because what we are doing here now is presenting to your Honor statements which were made while the parties held title, and not in view of any litigation. The theory, as I understand it, is that those statements should be received by the Court as evidence of the fact that those statements were made at the time, and that they are inconsistent with the positions which are now

being taken; the point being that they ought to be received and weighed by the Court in determining whether or not the position taken now is a position which is justified by the facts.

MR. GARRISON: Your Honor realizes that this is a question of a grant from the Government, and that grant either secured something to us or it did not. Anything that we said about that grant after it was made has nothing to do with the title. It is on the question of scope which he thinks—and I do not care what he thinks—thinks we made a statement which he considers erroneous in respect to the scope of our patent, inconsistent with what we now say it was. Supposing it was. We could not affect the Government. We had no relations with him. He cannot say we are estopped because of some statements then made, if your Honor please. It may be, as I said yesterday, with regard to those statements, that if they were erroneous, the Government could cancel the second grant to Greenway of the patent, but how could anything Greenway said in 1914 affect the grant which the Government made to him in 1910.

MR. NEARY: If your Honor please, it is not a question of title necessarily. These questions are not confined to title—though in a broad sense this is a question of title, because it is a question of the scope of the patent, but the principle is absolute regardless of the question of whether it is one of title to this patent. If it is merely evidence of the state of mind of the parties at the time, it is receivable in evidence with exactly the same force as if it were with respect to the title to the property. Here we have a situation where Greenway, one of the patentees of the patent in suit, and the patentee of patent No. 1,099,699, is making statements with regard to the state of mind at the time of the granting of the patent in suit; and the Greenway patent No. 1,099,699 is issued by the Patent Office upon the basis of that. We further think the statements by the President, John Ballot, the President of Minerals Separation, Limited, confirming

and accepting those statements and putting them forward as the position of the holder of that title——

THE COURT: Do you need to use this in your arguments on either side today?

MR. GARRISON: No, we do not.

MR. DAVIS: Well, I would use it if it were in.

THE COURT: Suppose we leave it for the moment. I would want to look at some of the authorities on that.

MR. NEARY: May we present a memorandum on that?

THE COURT: Yes, if you want to, and I will decide that later, and hear your argument without that.

MR. GARRISON: Mr. Neary, you will send us a copy of your memorandum so that we can reply.

MR. NEARY: Yes.

THE COURT: Yes, just a brief memorandum. I want to look at the cases.

ARGUMENTS

(See Plaintiff's and Defendant's oral arguments.)

sition was expressly waived by stipulation of counsel; that certain exhibits offered for identification by the parties have been marked by me with their proper designations and numbers and that the said exhibits so marked remain by stipulation of counsel in the custody of the counsel who offered the same for identification; it being stipulated that the same will be produced for examination by the said counsel on the call of counsel for the opposing party.

I further certify that the reason for taking such deposition was and is that the deponent lives in Palo Alto, California, more than one hundred miles from the place where said suit is pending, and in another judicial district, and that at the time said deposition was taken he was about to return to the said Palo Alto, California, and did so return as soon as said deposition was taken.

I do further certify that I am neither of counsel for, nor attorney to, either of the parties to said cause, nor interested in the event or outcome of said cause, and that it being impracticable for me to deliver said deposition with my own hand into the Court for which it was taken, I have retained the same for the purpose of being sealed up and directed with my own hand and transmitted to the said Court for which it was taken, and to remain under my seal until there opened.

Witness my hand and notarial seal this 16th day of March, A. D. 1922.

FRED BURGER,
Notary.

(Seal)

STIPULATION RE-ROBERTS' AFFIDAVIT. PLAINTIFF'S EXHIBIT NO. 17.

At request of counsel for defendant, counsel for plaintiff upon further investigation have ascertained that the Miami Copper Company and the Ray Consolidated Copper Company have used and are using blast-furnace oil.

It is understood and agreed that

(a) Pensacola No. 350 pine oil is the entire crude tar product resulting from the destructive distillation of pine wood and is the source from which Pensacola No. 75 and No. 80 oils, and Pensacola No. 200 and No. 400 Creosotes are derived.

(b) Barrett No. 612 creosote is derived from coal tar.

(c) Barrett No. 4 creosote is derived from coal tar.

(d) G. N. S. No. 26 creosote is derived from coal tar.

(e) G. P. T. pine oil is a product resulting from the destructive distillation of pine wood.

(f) Crude "turps" is crude turpentine.

HENRY D. WILLIAMS,
Of Counsel for Plaintiff.

WILLIAM H. DAVIS,
Of Counsel for Defendant.

IN THE DISTRICT COURT OF THE UNITED STATES,
DISTRICT OF MAINE,
SOUTHERN DIVISION.

Minerals Separation North American Corporation,
Plaintiff,

v.

Magma Copper Company,
Defendant.

IN EQUITY, No. 800, ON LETTERS PATENT No. 962,678.

OPINION OF THE COURT.
February 3, 1928.

PETERS, *J.:*

This suit, originally begun with two plaintiffs, and involving patent No. 835,120, as well as patent No. 962,678, has resolved itself, after various amendments and the filing of supplemental bills and answers, into a suit by the Minerals Separation North American Corporation against the Magma Copper Company for infringement of patent No. 962,678, and, by virtue of the pleadings, involves both the validity of that patent and the question of infringement. Claims 1 and 2 only are in issue, Claim 1 being as follows:

> "The hereindescribed process of concentrating ores which consists in mixing the powdered ore with water containing in solution a small quantity of a mineral-frothing agent, agitating the mixture to form a froth and separating the froth."

Claim 2 is identical with Claim 1, except that the mineral-frothing agent is described as "organic"; but, as practically all mineral-frothing agents are organic substances, this need not be considered. Patent No. 835,120 is the noted mineral

froth flotation patent that has been much litigated in different circuits and has been before the Supreme Court twice. Minerals Separation, Ltd. v. Hyde, 242 U. S. 261, and Minerals Separation, Ltd. *et al.* v. Butte, etc. Company, 250 U. S. 336. Patent No. 962,678, the one now in suit, has been before the District Court of Delaware and the Court of Appeals of the Third Circuit and by both courts held valid. Minerals Separation, Ltd. v. Miami Copper Company, 244 Fed. 752. Minerals Separation, Ltd. v. Miami Copper Company, 237 Fed. 609.

It appears that the invention covered by the patent in suit has been for many years in quite universal use in the business of concentrating copper and zinc ores and has been largely accepted in that industry as solving in a practical way a previously unsolved and perplexing problem. It is stated in the plaintiff's brief that its use is "enormous" and world-wide. In spite of the extraordinarily heavy burden resting upon the defendant to overcome the presumption, arising from the decisions in the Third Circuit, the general recognition of commercial utility and the fact that letters patent have issued, the able counsel for the defendant have, with apparent confidence, interposed notable and impressive defenses to the bill of complaint. A careful and somewhat long-continued consideration of the voluminous evidence has led me to the conclusion that the fundamental difference between the parties is in their point of view of the subject-matter of the two patents and that a determination of the correct viewpoint if it can be reached, will go a long way toward settling the applicability and value of the arguments on the one side and the other.

Owing to the grounds upon which this decision is based and the fact that the circumstances and the arguments affecting the two patents, as well as the great amount of literature concerning the subject, will be familiar to anyone who will probably have occasion to read this opinion, it will be necessary only to outline the general field of dispute.

Prior to the invention embodied in patent No. 835,120, hereafter called the first patent, it was well known in the art

of flotation concentration, as stated by the Supreme Court in the Hyde case, "that oil and oily substances had a selective affinity or attraction for, and would unite mechanically with, the minute particles of metal and metallic compounds found in crushed or powdered ores, but would not so unite with the quartz, or rocky non-metallic material, called gangue." Prior to the first patent many different processes of concentration were tried, with more or less success, based upon and endeavoring to utilize this known "preferential affinity" of oily substances for mineral particles in a mixture of ground ore and water. In the Hyde case the Supreme Court clearly considered the first patent as a process patent based upon "this mysterious affinity of oil for the metallic particles of the ore," whereby the metallic particles were coated with a thin film of oil. That patent was held by the Court to represent a striking advance in the art, turning previous "failure into success."

Into this field, with the process of the first patent as a part of the prior art, came the patentees of the second patent, —the patent in suit,—with an undoubted improvement; a process not dependent upon the oily coating of the mineral particles but utilizing a hitherto unknown property of mineral-frothing agents in solution to form air bubbles which attract and attach themselves to the uncoated and unoiled mineral particles. It should be said, however, that the defendant attacks the accuracy of the above general statement and maintains that it is not true that in the process of the second patent the mineral-frothing agent in solution forms bubbles which attach themselves to *uncoated* mineral particles. It says that, while the frothing agent goes wholly into solution in the water of the "pulp," a small part of it comes out again by "adsorption" and does coat, minutely, the mineral particles,—so that it is the same process with a different agent. This is a region of disputation where experts and scientists occupy the field alone. They have battled valiantly, but with the result that I cannot say that I am convinced that the "adsorption" theory has any practical applicability here.

The defendant asserts with some force that the process of the second patent, at most, is nothing more than the process of the first patent, with the substitution of a soluble for an insoluble frothing agent; that it involves no patentable invention and is void for anticipation. The defendant attacks claims 1 and 2 as too indefinite in that they claim a monopoly on the basis of a quality (solubility) which quality does not measure the availability of the substances for flotation purposes.

The plaintiff avers that the claims are not based on solubility but on the mineral-froth-forming quality of an agent in solution, and, regarding both patents as process patents as distinguished from patents for agents, points to the different principles of action in the two processes. The processes of the two patents are undoubtedly alike in this, that they can be carried out by the use of the same apparatus with the same manipulation. But the principle of action,—so far as it is known,—involved in the process in suit, is not the preferential affinity of the frothing agent used for the mineral particles or the coating of those particles, or the attachment of air bubbles to coated particles, as in the first patent, because the frothing agent goes into solution without coating either mineral or gangue, and the law of attraction and attachment of air bubbles to oil coated mineral particles cannot apply. The process in suit, as it is put by counsel for plaintiff in their brief, "proceeds by reason of the peculiar character of the air bubbles produced in water modified by the presence of the dissolved mineral frothing agent employed and by reason of the attraction and attachment of such air bubbles for uncoated metalliferous mineral particles."

I consider that the decisions of the Supreme Court in the Hyde case and in the Butte case, above mentioned, are in harmony with the position of the plaintiff rather than with that of the defendant. The Court evidently regarded the first patent as a process patent limited to the use of oil or oily substances. In the Butte case, involving the first patent, the Court confirmed to the patentees their process claims involving the use of any of the class of oily (insoluble) mineral-

frothing agents that acted by preferential affinity in coating the mineral. By implication it confirms to the patentees here their process claims involving the use of any of the class of soluble mineral frothing-agents that act on the different principle of going into solution, not coating the mineral, but modifying the water in some unknown way, to accomplish the same result in the end, *i. e.*, bringing up to the surface the mineral particles attached to the froth.

It can be said of this process, as was said of the first process by the Court in the Butte case, that "the patentees discovered the described process for producing the result or effect, the metal-bearing froth, but they did not invent that result or froth,—their patent is on the process, it is not and cannot be on the result,—and the scope of their right is limited to the means they have devised and described as constituting the process." It seems to me that the principle defenses must fail for the reason that they are based on a theory of difference between the two patents that apparently would not be accepted by the Supreme Court, according to my interpretation of its two decisions. But, however that may be, these and the other more technical defenses were doubtless considered by the Circuit Court of Appeals in the Third Circuit in the suit of Minerals Separation, Ltd. v. Miami Copper Company, 244 Fed. 752, involving the validity of this same patent and, while the parties were not the same, I am practically required to follow that decision, based upon substantially the same facts, unless manifest error clearly appears. The precedents in this circuit are very strong to that effect. In Beach v. Hobbs, *et al.*, 92 Fed. 146, 147, Judge Colt for the Circuit Court of Appeals said:

> "Although the defendants in this case are not the same, or in privity with the defendants in the other cases, we think, as a general rule, and especially in patent cases, we should follow the decision of the Circuit Court of Appeals of another circuit upon final hearing with respect to the issues if based upon substantially the same state of facts, unless it should clearly appear that there was manifest error."

Judge Putnam, in Hatch Storage Battery Co. v. Electric Storage Battery Co., 100 Fed. 975, 977, had previously said:

> "We are saved, by the amount of judicial literature relating to the subject-matter of this case, from doing much more than giving our conclusions. Indeed, it is not even necessary to fully recite the claims, as the patent is found at length in Electrical Accumulated v. Brush Electric Co., 1 U. S. App. 320, decided by the Circuit Court of Appeals for the Second Circuit, the opinion having been rendered by Judge Shipman. . . . The validity of claims 1, 2, 3, 6, 7 and 12 of the patent in issue was fully sustained. That covers all in issue here except 9 and 10. The case was very elaborately considered. The decision has never been judicially overruled, doubted or qualified. Therefore, on the principles which we have stated, although it was against a different respondent from that at bar, it must be accepted as conclusive on this appeal as to the validity of claims 1, 2, 3 and 12."

In Pratt v. Wright, *et al.*, 65 Fed. 99, Judge Wallace said:

> "The questions are fairly doubtful; and that being so, it would be unseemly not to follow a decision which is entitled to the greatest respect, made by a court of coordinate jurisdiction, and determining the title to the same property."

I think no one who studies the evidence, the diametrically opposed theories of the experts and the elaborate arguments in this case, can say conscientiously that it "clearly appears that there was manifest error" in the decision of the Circuit Court of Appeals in the Third Circuit. The most that can be said seems to me to be that possibly other minds might take a different view of the fundamental difference between the two patents, in which case, unless the decisions of the Supreme Court are construed to impliedly prevent arguments of defendant's counsel based on anticipation and non-patentability would be very pursuasive. However, that possibility is far from a situation justifying me in departing from the previous decision and consequently, for me, "it would be unseemly not to follow a decision which is entitled to the greatest respect . . . determining the title to the same property."

It follows that the patent is held valid.

It seems quite clear that the claim of non-infringement should be decided against this defendant.

The operation of the defendant's mill and the process described in the patent in suit are substantially alike except that the defendant's pulp is alkaline and not acid, and a further difference claimed by the defendant in the matter of agitation of the pulp, in that any agitation affecting its pulp is produced by air introduced under pressure, sometimes spoken of as pneumatic agitation, and not all by any mechanical or obviously violent means to which the defendant claims the plaintiff is limited. There is a difference also in the size and appearance of the bubbles in the two processes, but not, apparently, in their accomplishment.

By reason of these differences the defendant denies infringement.

The specification of the patent does not disclose how to carry on the process or that it can be carried on except in an acidified pulp.

Claims 1 and 2 in question are not limited to an acid pulp but are broad enough to cover any pulp whether acid, alkaline or neutral.

The defendant's position is that claims 1 and 2 are void because they attempt to claim more than the patentees had discovered or disclosed in the specifications and are not infringed because the claims, based upon the invention disclosed in the patent, must be limited to the carrying of the process in an acidified pulp, while the defendant's pulp is alkaline. In other words, this defense is that the claims in issue are void because they are not limited to acidified pulps, and that the defendant does not infringe because it does not use an acidified pulp.

It is apparently true that the inventors disclosed an acid pulp and did not know that the process could be used otherwise. It was widely understood at that time that nothing but an acid process would work in their concentration process, and it was the general custom to use an acidified pulp. This, however, was not a part of the contribution by the patentees to

the flotation art. What they contributed was a process of broth flotation employing a mineral-frothing agent in solution. Even if the patentees did not know that the process described by them could be carried on with an alkaline pulp they did not limit themselves in that respect and it is sufficient if the real novelty of their invention is broad enough to support the claims, as it appears to be.

This matter, however, was covered by the decisions in the Miami case in the Third Circuit which I have already indicated, in my opinion, should bind me in the situation as I find it disclosed. The Court there, in deciding adversely to similar contentions, adverted to the matter of acid in the pulp as follows:

> "We may also note that while the addition of an acid to the mineral-frothing agent is described as part of the process, this was at that time a usual practice, and in any event is not an element in the claim now in issue."

Counsel for defendant here say that we have not the evidence in the Miami case before us, and that for all it appears the defendant in the Miami case may have used an acid pulp; but I find on page 631 of the opinion of Judge Bradford, in that case (237 Fed. 609), a statement that the defendant "does not use acid in its process." The claims in issue there, as here, were claims not limited to an acidified pulp. So claims 1 and 2 here, not being limited to acid processes, being valid, are infringed by the defendant's alkaline process.

It remains to consider the position of the defendant that "the claims are not infringed by the defendant's process because the claims were deliberately limited by the patentees to the agitation froth process, *i. e.*, a process in which the froth is formed by agitation, and the defendant uses the pneumatic-flotation process in which the froth is not formed by agitation."

The defendant's statement of this matter of defense, as above quoted, involves a characterization of the plaintiff's process as "the agitation froth process" and the statement of fact that in the pneumatic process used by the defendant

"the froth is not formed by agitation." If by that description of the plaintiff's process is meant one whereby the froth is formed by agitation as contrasted with a process where the froth is formed otherwise than by agitation, the characterization is apparently accurate and without ambiguity. The plaintiff's process comprises three essential parts, (1) mixing the powdered ore with water containing in solution a frothing agent, (2) agitating the mixture to form a froth, and (3) separating the froth. The process is undoubtedly an agitation froth process. The claim limits it to an agitation froth process, with no limitations on the kind of agitation.

Upon the evidence, however, I am unable to agree with the statement that in the defendant's process,—the alleged infringing process,—the froth is not formed by agitation. The evidence of the process, its exemplification by the experiments in Boston for the benefit of the Court, and common-sense reasoning from known facts, point conclusively to the contrary. The defendant's process is the Callow cell process, using a tank with a canvas or porous bottom through which air under pressure is forced into the pulp body contained in the tank. In this way myriads of small air bubbles are formed throughout the liquid mass and finally accumulate at the surface in the form of froth bearing the minute particles of mineral. From actual observation of the process, as well as otherwise, I am convinced that the froth is formed by the agitation induced by the compressed air liberated in the mixture through the porous bottom; that is to say, by the agitation in combination with the frothing agent which always has to be present. One is as important as the other.

In the trial of the case this particular defense of non-infringement appeared to be based not so much on an agitation process, as it was on mechanical agitation as against pneumatic agitation. It can hardly be claimed that there is not agitation in both processes. The mechanical agitation is apparently more violent, but may not be more pervasive than the agitation caused by compressed air. At least each is effective for the purpose and I think it cannot be successfully

claimed that frothing would take place without one or the other.

Patent No. 835,120, called the first patent above, being the patent that required the use of oil, is the patent that features the mechanical agitation, which was required to be of considerable intensity and duration to disseminate the minute amount of oil throughout the mixture. In any soluble frothing agent process less agitation would be required as the agent tends to disseminate itself. The agitation in the defendant's process is caused by compressed air let into the pulp. The question is simply whether the claims in the patent in suit are broad enough to cover that method of agitation. It would seem that the question answers itself, because the language is "agitating the mixture to form a froth." I can see no reason why the language should not receive its ordinary, natural meaning and be construed like the language of any contract. Its terms are perfectly plain and unambiguous. As was said by Judge Anderson in I. T. S. Rubber Co. v. Essex Rubber Co., 270 Fed. 593, 600, quoting from the Circuit Court of Appeals of the Eighth Circuit, "A patent is a contract between the Government and the patentee . . . and the rule for the construction of contracts generally controls in its interpretation, and when its terms are plain and the intention of the parties clearly manifest therefrom, they must prevail."

This doctrine is stated in O'Brien-Worthen Co. v. Semple, 209 Fed. 847, also quoted by Judge Anderson:

> "The specification and claims of a patent constitute a contract between the United States and the patentee, and they are to be read and construed together in the same way and by the same rules by which other contracts are interpreted. The specifications which form a part of the same petition or application as the claims must be read and interpreted with them, not for the purpose of limiting, or of contracting, or of expanding the latter, but for the purpose of ascertaining from the entire agreement of which each is a part, the actual intention of the parties."

I can find no satisfactory foundation for the defendant's theory that the words in the claims, "agitating the mixture to form a froth," have any special or recognized significance to one skilled in the art, or that the words carry back to the agitation froth process of patent No. 835,120, and exclude other froth flotation processes.

Indeed, this construction is negatived by the very language of the defendant in stating this "seventh defense," where it is said that the claims (1 and 2) were limited to "the agitation-froth process, *i. e., a process in which the froth is formed by agitation.*" That is what I find it to be, that and nothing less, and that, by the plain meaning of the language, covers agitation to form the froth whether caused by stirring with a paddle or stirring with compressed air. In both cases air is introduced into the mixture, and has to be, to make it froth. As was said by Prof. Taggart, expert witness for defendant, in an article he wrote on the subject before he was connected with the case, "the only difference is in the method of introducing air."

I find that the defendant's process in this respect also is fairly covered by the plaintiff's claims, and is an infringement.

Both the plaintiff and the defendant here claim to be supported in their positions on this matter of infringement under the seventh defense by the opinion of the Court in the Third Circuit in the Miami case.

That case did not necessitate the decision of the point here in issue because the defendant there used the mechanical agitation emphasized in the first patent in connection with the pneumatic Callow cell process.

The Court certainly did use some expressions which indicated that it would not have considered the agitation of the Callow cells alone the equivalent of the violent agitation of the first patent (Patent 835,120 and not the patent in suit). But it did not pass upon the question whether the use of the Callow cell alone without other agitation would be an infringe-

ment of either patent. On the contrary it expressly negatived any such intention in these words:

> "While we are loath to omit from our consideration and judgment anything affecting this very important patent and the art to which it relates, we feel, nevertheless, that we cannot consider and adjudge with propriety or authority a process with respect to which the plaintiff has had no opportunity to produce testimony and which was not embraced in the decree we are reviewing."

It follows that the bill is sustained and the plaintiff entitled to appropriate relief.

INTERLOCUTORY DECREE.

This case having come on for trial and having been tried in open court and argued by counsel Henry D. Williams, William Houston Kenyon and Lindley M. Garrison, Esqs., in behalf of plaintiff and William H. Davis, Esq., in behalf of defendant, and due consideration being had, it is

ORDERED, ADJUDGED and DECREED by the Court as follows:

That the Letters Patent of the United States issued to Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins on June 28, 1910, No. 962,678 for improvements in ore concentration are good and valid in law as to claims 1 and 2 thereof;

That the said Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins are the true, original, first and joint inventors of the invention described in the said letters patent and particularly pointed out in claims 1 and 2 thereof;

That the plaintiff, Minerals Separation North American Corporation is the lawful, sole and exclusive owner of said letters patent;

That the defendant Magma Copper Company has infringed the said letters patent as to claims 1 and 2 thereof

and upon the exclusive rights of the plaintiff therein under the same by carrying on the process of ore concentration set forth and claimed in said letters patent as aforesaid;

That said letters patent having expired on June 28, 1927, no injunction will now be issued thereon;

That the plaintiff do recover of the defendant the profits which the defendant has derived, received or made by reason of the aforesaid infringement, and that plaintiff do also recover from defendant any and all damages sustained by the plaintiff by reason of said infringement; and it is hereby referred to Philip G. Clifford as a Master of this court to take and state the account of such gains, profits and advantages and to assess such damages and to report thereon with all convenient speed; and the defendant, its officers, servants, agents, attorneys, clerks and workmen are hereby directed and required to attend the aforesaid Master from time to time as required and to produce before him such books, papers and documents as relate to the matters at issue, and to submit to such oral examination as the Master may require;

That the plaintiff do recover of the defendant its costs and disbursements in this suit to be taxed.

Dated Portland, Maine, April 20, 1928.

JOHN A. PETERS.

Form approved.

HENRY D. WILLIAMS,
Of Counsel for Plaintiff.

SIDNEY ST. F. THAXTER,
Solicitor and of Counsel for Plaintiff.

WILLIAM H. DAVIS,
Of Counsel for Defendant.

ALBERT S. WOODMAN,
Solicitor and of Counsel for Defendant.

NOTICE OF APPEAL.

The above-named defendant, MAGMA COPPER COMPANY, conceiving itself aggrieved by the interlocutory decree entered herein on April 20, 1928, adjudging claims 1 and 2 of United States Patent No. 962,678 good and valid in law and infringed by defendant, hereby respectfully appeals from said decree to the United States Circuit Court of Appeals for the First Circuit for the reasons set forth in the assignment of errors filed herewith and prays that citation be issued as provided by law to the above-named plaintiff, Minerals Separation North American Corporation, commanding it to appear before said Circuit Court of Appeals to do and receive what may appertain to justice to be done in the premises; that a transcript of the pleadings, proceedings, testimony, exhibits and orders, together with a copy of the opinion of this Court filed in this case upon which said decree was entered, duly authenticated by the clerk of the court, be transmitted to the United States Circuit Court of Appeals for the First Circuit under the rules in such cases made and provided.

MAGMA COPPER COMPANY,
By ALBERT S. WOODMAN,
Portland, Maine,
Solicitor for Defendant.

MERTON W. SAGE,
165 Broadway, N. Y. C.
Of Counsel for Defendant.

Dated New York, N. Y., May 8, 1928.

Service acknowledged this eighth day of May, 1928.

HENRY D. WILLIAMS,
Of Counsel for Plaintiff.

It is so ordered.

JOHN A. PETERS,
U. S. District Judge.

Dated May 15, 1928.

ASSIGNMENT OF ERRORS.

Now comes the defendant herein, Magma Copper Company, and makes the following assignment of errors:

1. The District Court erred in adjudging claims 1 and 2 of United States Patent No. 962,678 good and valid in law.

2. The District Court erred in adjudging that defendant, Magma Copper Company, has infringed claims 1 and 2 of said patent.

3. The District Court erred in holding that said patent was not anticipated and invalid in view of the prior state of the art.

4. The District Court erred in holding that claims 1 and 2 of said patent are not limited to an acid pulp.

5. The District Court erred in holding that claims 1 and 2 of said patent are not limited to the agitation froth process of flotation.

6. The District Court erred in holding that the claim of non-infringement should be decided against defendant.

7. The District Court erred in holding that in defendant's process the froth is formed by agitation.

8. The District Court erred in finding that defendant's process was covered by plaintiff's claims and was an infringement thereof.

9. The District Court erred in not dismissing the bill of complaint with costs to defendant.

By ALBERT S. WOODMAN,
Portland, Maine,
Solicitor for Plaintiff-in-Error (Defendant Below).

MERTON W. SAGE,
165 Broadway, New York City,
Of Counsel for Plaintiff-in-Error (Defendant Below).

Dated New York, N. Y., May 10, 1928.

Service acknowledged this tenth day of May, 1928.

HENRY D. WILLIAMS,
Of Counsel for Defendant-in-Error (Plaintiff Below).

ORDER FIXING APPEAL BOND.

Notice of appeal and assignment of errors having been filed in this court by the defendant herein, MAGMA COPPER COMPANY, on the fifteenth day of May, 1928, it is hereby

ORDERED, that a bond for costs on appeal in the sum of one thousand ($1000) dollars without surety is to be furnished.

JOHN A. PETERS,
U. S. District Judge.

The above order is hereby consented to this eighth day of May, 1928.

HENRY D. WILLIAMS,
Of Counsel for Minerals Separation North American Corporation.

BOND ON APPEAL.

KNOW ALL MEN BY THESE PRESENTS, that Magma Copper Company, a corporation duly organized and existing by law and having a principal place of business in New York, in the County and State of New York, acknowledges itself indebted to Minerals Separation North American Corporation, appellee in the above-entitled cause in the sum of one thousand ($1000) dollars, conditioned that, whereas, on the 20th day of April, 1928, in the District Court of the United States for said Southern Division of said District of Maine, in a suit

pending in that court, wherein Minerals Separation North American Corporation was plaintiff and said Magma Copper Company was defendant, numbered 800 on the Equity docket of said court, a decree was entered against said Magma Copper Company, and the said Magma Copper Company having given notice of an appeal to the United States Circuit Court of Appeals for the First Circuit, and filed the original thereof in the office of the clerk of said court to reverse the said decree, and a citation directed to the said Minerals Separation North American Corporation citing and admonishing it to be and appear at a session of the United States Circuit Court of Appeals for the First Circuit to be holden in the City of Boston, in the Commonwealth of Massachusetts, on the fourteenth day of June, A. D. 1928 next.

Now, if the said Magma Copper Company shall prosecute its appeal to effect, and pay all costs if it shall fail to make its plea good, then the above obligation to be void, otherwise to remain in full force and virtue.

MAGMA COPPER COMPANY,
By (Sgd.) CHARLES F. AYER,
Its President.

Attest:

H. E. DODGE,
Secretary.

May 16, 1928.

Approved:

JOHN A. PETERS,
District Judge.

CITATION.

UNITED STATES OF AMERICA, *ss.:*

THE PRESIDENT OF THE UNITED STATES,

To Minerals Separation North American Corporation,

GREETING:

You are hereby cited and admonished to be and appear before a United States Circuit Court of Appeals for the First Circuit, to be held in the City of Boston, State of Massachusetts, in the District and Circuit above named on the fourteenth day of June, 1928, pursuant to an appeal filed in the clerk's office of the District Court for Maine, Southern Division, wherein MAGMA COPPER COMPANY is appellant and you are appellee, to show cause, if any there be, why the decree in said appeal mentioned should not be corrected and why speedy justice should not be done to the parties in that behalf.

Given under my hand at Portland in the District of Maine this 15th day of May, A. D. 1928.

JOHN A. PETERS,
United States District Judge, for the District of Maine.

Service of the within citation, with copy, accepted this 15th day of May, 1928.

SIDNEY ST. F. THAXTER,
Of Counsel for Minerals Separation North American Corporation.

ORDER APPROVING STIPULATED PRÆCIPE.

And Now, to wit, this sixteenth day of May, 1928, on motion for counsel for the respective parties, it is ordered by the Court that the foregoing stipulation be and the same hereby is approved and the clerk is hereby authorized to certify the transcript of record prepared in accordance with the foregoing stipulation and to transmit the same to the United States Circuit Court of Appeals for the First Circuit at Boston, Massachusetts.

John A. Peters,
U. S. District Judge.

STIPULATED PRÆCIPE FOR TRANSCRIPT OF RECORD ON APPEAL.

And Now, to wit, this ninth day of May, 1928, it is stipulated between counsel for the respective parties in the above-entitled cause, subject to the approval and direction of the Court, that in the transcript of record of this case to be certified on appeal to the United States Circuit Court of Appeals for the First Circuit, the clerk in making up said transcript shall incorporate therein the following:

1. The docket entries to date.

2. The record on final hearing printed for use in the District Court and including

Volume I.

(a) Bill of complaint

(b) Answer

(c) Order and stipulation *re* filing of supplemental and amended bill of complaint

(d) Supplemental and amended bill of complaint

(e) Answer to supplemental and amended bill of complaint

(f) Notice, motion and affidavits *re* order to inspect defendant's mill at Superior, Arizona

(g) Order permitting plaintiff to inspect defendant's mill at Superior, Arizona

(h) Order granting leave to file defendant's interrogatories

(i) Defendant's interrogatories and plaintiff's answers and objections thereto

(j) Clerk's docket entry *re* objections to defendant's interrogatories

(k) Defendant's motion for further particulars and order thereon

(l) Plaintiff's bill of particulars

(m) Defendant's notice and motion to amend answer and order thereon

(n) Plaintiff's notice limiting charge of infringement to Claims 1 and 2 of patent in suit

(o) Motion to amend bill of complaint

(p) Defendant's notice under Equity Rule No. 58

(q) Answer of plaintiff to defendant's notice under Equity Rule No. 58

(r) Stipulation *re* defendant's mill operations

(s) The trial record.

VOLUME II.

(t) Plaintiff's exhibits.

VOLUME III.

(u) Defendant's exhibits.

3. The opinion of Judge John A. Peters, filed on February 3, 1928.

4. The interlocutory decree entered April 20, 1928.

5. Notice of appeal and assignment of errors, filed May 15, 1928.

6. Order fixing appeal bond.

7. Appeal bond.

8. Citation.

9. This stipulation and order of Court thereon.

10. Clerk's certificate.

MERTON W. SAGE,
Of Counsel for Defendant-Appellant.

HENRY D. WILLIAMS,
Of Counsel for Plaintiff-Appellee.

STIPULATION AS TO CORRECTNESS OF RECORD.

It is hereby stipulated and agreed that the foregoing Volume I and accompanying Volume II (Plaintiff's Exhibits) and Volume III (Defendant's Exhibits) is a true transcript of the record of the District Court in the above-entitled cause as agreed upon by the parties.

HENRY D. WILLIAMS,
Of Counsel for Plaintiff.

MERTON W. SAGE,
Of Counsel for Defendant.

Dated New York, N. Y., June , 1928.

CLERK'S CERTIFICATE.

I, John F. Knowlton, Clerk of the District Court of the United States of America for the District of Maine, do hereby certify that the foregoing Volume I and the accompanying Volume II (Plaintiff's Exhibits) and Volume III (Defendant's Exhibits) is a correct transcript of the record of the District Court in the above-entitled cause as agreed upon by the parties.

IN TESTIMONY WHEREOF, I have caused the seal of the said Court to be hereunto affixed, at the City of Portland, in the District of Maine, this

(Seal) day of in the year of our Lord one thousand nine hundred and twenty-eight and of the Independence of the said United States of America the one hundred and fifty-second.

.....

Clerk.

PROCEEDINGS IN CIRCUIT COURT OF APPEALS

On October 2 and 3, 1928, this cause came on to be heard, and was fully heard by the court, Honorable George H. Bingham, Honorable Charles F. Johnson and Honorable George W. Anderson, Circuit Judges, sitting.

Thereafter, to wit, January 10, 1929, the following opinion of the court was filed:

UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FIRST CIRCUIT, OCTOBER TERM, 1928

No. 2259

MAGMA COPPER COMPANY, Defendant, Appellant,

v.

MINERALS SEPARATION NORTH AMERICAN CORPORATION, Plaintiff, Appellee

Appeal from the District Court of the United States for the District of Maine

Before Bingham, Johnson and Anderson, JJ.

OPINION OF THE COURT—January 10, 1929

BINGHAM, J.:

This is an equity suit brought in the federal District Court for Maine by the Minerals Separation North American Corporation, a Maryland corporation, and the Minerals Separation Limited, a British corporation of London, England, against the Magma Copper Company, a Maine corporation, for infringement of Letters Patent No. 835,120, applied for May 29, 1905, issued November 6, 1906 to Henry Livingstone Sulman, H. F. Kirkpatrick-Picard and John Ballot, all of London, England, and owned by the Minerals Separation Limited; and for infringement of Letters Patent No. 962,678, applied for April 30, 1909, issued June 28, 1910 to Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, all of London, England, and owned by the Minerals Separation North American Cor-

poration. The proceeding was begun in January, 1920. Just prior to the expiration of patent No. 835,120, by agreement of parties, the complaint with relation to that patent was dismissed, and the Minerals Separation North American Corporation was permitted to file a supplemental and amended bill of complaint for infringement of patent No. 962,678 only.

This patent is said to be for "certain new and useful improvements in ore concentration" and that its object is "to separate certain constituents of an ore such as metallic sulfids from other constituents such as gangue when the ore is suspended in a liquid such as water."

The claims in issue are Nos. 1 and 2:

"1. The hereindescribed process of concentrating ores which consist- in mixing the powdered ore with water containing in solution a small quantity of a mineral-frothing agent, agitating the mixture to form a froth and separating the froth."

The second claim is identical with the first except that the frothing agent is described as "an organic mineral-frothing agent."

The defenses here relied upon are invalidity and non-infringement; that the invalidity of these claims is due (1) to anticipation; (2) to prior invention and prior patenting in the United States; (3) to the three patentees not being joint inventors; and (4) that they are void, because they claim more than the patentees had discovered or more than they disclosed in the specification.

And as to non-infringement the defendant asserts, (1) that it does not use an acidified water or pulp to which the claims in issue must be limited by reason of the disclosure; and (2) that it does not use a process in which the froth is formed by agitation as set out in the claims. In the District Court these claims were held valid and infringed, and this appeal was taken.

In describing the process of the invention or discovery in the specification the patentees state:

"According to this invention the crushed ore is mixed with water containing in solution a small percentage of a mineral-frothing agent, (that is of one or more organic sub-

stances which enable metallic sulfids to float under conditions hereinafter specified) and containing also a small percentage of a suitable acid such as sulfuric acid, and the mixture is thoroughly agitated; a gas is liberated in, generated in, or effectively introduced into the mixture and the ore particles come in contact with the gas and the result is that metallic sulfid particles float to the surface in the form of a froth or scum, and can thereafter be separated by any well known means."

As a disclosure of the mineral-frothing agents used they state:

"Among the organic substances which in solution we have found suitable for use as mineral-frothing agents with certain ores are amyl acetate and other esters; phenol and its homologues; benzoic, valerianic and lactic acids; acetones and other ketones such as camphor. In some cases a mixture of two such mineral-frothing agents gives a better result than a single agent."

They also state that "the above mentioned mineral-frothing agents * * * are not intended to form an exhaustive list of suitable organic substances which may be used"; and that those above mentioned "are all more or less effective in the presence of an acid such as sulfuric acid."

They also state that "there are many organic compounds which in solution will not effect the result described," naming several, and that "a simple test is required in the case of varying ores or materials to determine which organic compound is most suitable."

As an example of one method of carrying out the invention it is further stated:

"Water containing a small percentage of sulfuric acid in solution say from .2% to 0.5%, and containing in solution a small quantity say 0.1% of one of the foregoing organic substances (say amyl acetate) is, with finely pulverized ore, introduced into an agitating apparatus, in the proportion of say 3 parts by weight of water to 1 part by weight of ore. The agitation is carried out in such a way as thoroughly to disseminate air through the mixture which is thereafter discharged into a spitzkasten. It is found that a coherent froth

or scum floates on the surface of the water" and "contains a large proportion of the metallic sulfids but is substantially free from gangue"; and that "any well known means may be employed for collecting the froth."

In attempting to differentiate the mineral-frothing agents of the patent which it discloses as being in solution, from the mineral-frothing agents of the prior art used in the concentration of ores, the patentees state:

"Hitherto many proposals have been made for the wet concentration of ores involving the addition to the liquid [water or acidified water] in which the ore is suspended of an immiscible liquid."

The specification then refers, for "an example" of the patentees' understanding of prior art mineral-frothing agents used in ore concentration, to the United States patent No. 777,274 issued to Cattermole, Sulman and Picard, December 13, 1904 and states that in that process "a fatty or resin acid or a phenol or a cresol" were used "by introducing the alkaline compounds of these materials into an acid liquid whereby these materials were liberated in an immiscible or insoluble condition and adhered to the mineral particles."

That process is known as the skin flotation process. Its specification discloses that the fatty or resin acids, or their derivatives cresol and phenol, are soluble compounds and that the improvement of that patent consisted in the method of thoroughly dispersing these compounds, due to their solubility, throughout the pulp in admixture with the mineral particles suspended in the ore mass; that when thus disseminated a small amount of mineral acid is added which decomposes the compound used, thus liberating the compound in intimate contact with the mineral particles which adhere thereto.

The specification then refers to another prior art flotation process but does not specify the agent employed.

It then goes on to state that the present process differs from the two mentioned and from other known concentration processes "by the introduction into the acidified ore pulp of a small quantity of a mineral-frothing agent, i. e., an organic compound in solution of the kind above referred

to and by the fact that the metalliferous particles are brought to the surface in the form of a froth or scum, not by mechanical means but by the attachment of air or other gas bubbles thereto."

In further differentiation of the present process from "frothing processes" of the prior art the patentees state:

"In the frothing processes hitherto known the substances used to secure the formation of a mineral-bearing froth has been oil or an oily liquid immiscible with water."

But that,

"According to this invention the mineral-frothing agent consists of an organic compound contained in solution in the acidified water."

Later they say:

"It is well known that certain of the organic substances we have referred to [organic compounds in solution, or contained in solution] are not soluble in water in all proportions and that if used in excess [of what is soluble in water] might partly remain insoluble in the acidified water and might become mechanically affixed to the metalliferous particles of the ore."

Having thus pointed out that some, at least, of the organic substances referred to were not wholly soluble in water when used in all proportions, and if used in excess of what would be dissolved in water might partly remain insoluble even in acidified water and become mechanically affixed to the metalliferous particles, the patentees entered a disclaimer:

"We disclaim any such use of these substances and only claim them in such amount as will enable them to dissolve in the acidified water."

It is apparent from a reading of the specification that the patentees did not undertake to name all the organic substances that would wholly dissolve in water, or all that were suitable if used only in amounts which would wholly dissolve in the water used, but did name as such agents amyl acetate and other esters; phenol and its homologues (of

which cresol is one); benzoic, valerianic and lactic acids; acetones and other ketones such as camphor; and in substance stated that the use of these substances wholly in solution was not disclosed or known in the prior art frothing processes; that in those processes the only substances known or used were an oil, or oily liquid, that was immiscible in water; that the use of substances wholly dissolved in water were not disclosed or known to coat or become mechanically affixed to metalliferous matter; that prior art uses and disclosures were limited to frothing agents that coat or become mechanically affixed to metalliferous matter; and that such agents are only those that are wholly immiscible in water. But in this case (see R. Vol. 1, pp. 492, 503) and elsewhere the plaintiffs have contended for a broader construction or scope of the patent and have claimed that organic compounds partly immiscible and partly soluble in water were within the scope of the patent and that such use was an infringement; and apparently they have obtained a decision to that effect in Miami Copper Co. v. Minerals Separation, Limited, 244 Fed. 752, on the ground that the use of an oil that went in part into solution, the balance remaining immiscible, was a conjoint use of the patent in suit and of patent No. 835,120, if the immiscible part was used in a fraction of one percent on the ore. We do not now stop to consider the soundness of this contention and holding, for it is not directly involved in this case, although it will be considered later.

In view of the disclosure of the patent in suit, above pointed out, limiting its scope to frothing agents wholly in solution in the amounts used, the question presented by the defense of anticipation is whether in the prior patented art there are disclosed frothing agents which go wholly into solution if used in the limited amount of a fraction of one per cent on the ore.

Among the prior art patents set up as an anticipation of the patent in suit is patent No. 835,120, above referred to as one of the patents put in issue in this case before the bill was amended. That patent, which expired in November, 1923, has been the subject of much litigation, and while at the time it became known the art was a refined one, the advance that it made and the recognition it received were held sufficient to entitle it to be considered an invention.

In its specification it states:

"This invention relates to improvements in the concentration of ores, the object being to separate the metalliferous matter, graphite, and the like from gangue by means of oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue."

The process of that patent is based on the discovery that if one of the "oils, fatty acids or other substances," which has a preferential affinity for metalliferous matter over gangue, is added to a freely flowing pulp of finely ground ore suspended in water, in an amount less than, or a fraction of, one per cent on the weight of the ore, and if the pulp is then vigorously agitated there will be found a froth or scum which will arise to the surface carrying with it the mineral particles.

Inasmuch as substances or agents having a preferential affinity for metalliferous matter over gangue have been known for generations and that patent disclosed that they also possessed the quality of modifying the water so that, on being agitated, it will yield a froth or scum, they are spoken of as mineral-frothing agents. The specification of that patent does not differentiate between the oils, fatty acids or other substances having a preferential affinity for metalliferous matter in the sense that they are soluble or insoluble, or in part soluble and in part insoluble, and the terms miscible and immiscible, soluble or insoluble, are nowhere mentioned in the specification or claims of the patent. The specification and claims, however, speak of the mineral particles being "oil-coated" or as having been brought into "efficient contact with" the oil or agent used.

On account of this the plaintiffs contend that the frothing agents disclosed in that patent (No. 835,120) are immiscible; and that only immiscible agents will coat or be brought into efficient contact with the mineral particles. While some of them are undoubtedly substantially insoluble or immiscible, others are substantially soluble, or partly immiscible and partly soluble; and the disclosure of the patent by the use of the terms "oils, fatty acids, or other substances having a preferential affinity for metalliferous matter over gangue," does not differentiate between them as frothing agents or point out any which, if used in the limited amount of the

patent [a fraction of one per cent on the ore], will not coat the mineral particles. On the contrary the specification and claims clearly give one undertaking to practice the process of the patent to understand that any or all of them will coat the mineral particles.

In Minerals Separation, Limited, v. Butte & Superior Mining Company, 250 U. S. 336, the Supreme Court had under consideration the scope of patent No. 835,120. The claims then in issue called for the use of an "oil," and "oily liquid" or an "oily substance." These terms were held to include, as some of the frothing agents of the process, oleic acid; petrol or gasoline; petroleum products, such as kerosene and fuel oil; and pine oil. The defendant in its alleged infringing process used as a frothing agent a compound made up of 18 per cent of pine oil, 12 per cent of kerosene and 70 per cent of fuel oil. The percentage of pine oil on the ore used by it was 27/100 of one per cent, or a fraction of one per cent on the ore, the critical amount of the patent. At that time the plaintiffs contended that the agent pine oil, which according to the evidence in this case is 79 per cent soluble, was the only efficient agent used, and that fuel oil and kerosene, which are substantially immiscible, were "inert and valueless, if not harmful." The question to be decided was whether "the use of a more efficient, in combination with a less efficient, oil of the patent, constituted infringement, where the former is used in an amount within the limits of the claims but the combined amount is in excess of such limit."

In the Butte case the Supreme Court pointed out that in a former case involving the same patent (Minerals Separation, Limited, v. Hyde, 242 U. S. 261) it had considered "the invention and usefulness of the claimed discovery," and in doing so had reviewed the state of the art, but "did not attempt to define the scope of the claims." (Butte case, p. 341.) And having prefaced its discussion with the further statement that the patentees had come late into a field where the art was largely developed and that their patent "must be construed strictly," though fairly, it said:

"With the state of the prior art in mind [for that see Hyde case], we come to consider the nature and the extent of the disclosures of the patent in suit [No. 835,120], but

only with respect to the kinds and quantities of oil which may be used in the process.

"The specification recites that the invention of the patent relates to an 'improvement' upon prior processes employed in ore concentration 'by means of oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue.' "

The court then points out the specific disclosures of the specification and claims intended to describe the advance which the patentees claimed to have made over the prior art Cattermole [No. 777,273] agglomeration of metalliferous matter into granules, which separate from the gangue and sink to the bottom of the pulp. Having done this it says:

"The patent in suit was applied for in this country on May 29, 1905, within a few weeks after the discovery which it embodies was made, and * * * this discussion of its terms makes it clear, that the only disclosure as to the kind and amount of oil which the patentees made to the public as necessary to the practicing of their process is that it must be an oil or oily substance, or oily liquid having a 'preferential affinity for metalliferous matter,' and that it shall be limited in amount 'to a fraction of one per cent on the ore.' "

In other words it was there held that the patentees of No. 835,120 were not, by the terms of their patent, limited as to the kind of oil, oily liquid or oily substance to the use of a kind that was immiscible, or partly immiscible and partly dissolvable; that the only limitation was that it should have a preferential affinity for metalliferous matter.

The court then takes up the plaintiffs' argument, based upon the provision of the claims, that the pulp mixture shall be agitated "until the oil-coated mineral matter forms into a froth," as serving "to differentiate the frothing oils from others having the required preferential affinity, but which, when agitated in the mixtures, may not produce the characteristic froth [immiscible, if such there are], and that a proper construction of the patent limits it to such frothing oils [oils soluble in whole or in part] and renders the use of them in a fraction of one per cent on the ore an infringement, when used with non-frothing oils [immiscible, if such

there are] having the required affinity in amounts sufficient to make the combination exceed the quantity limit of the patent." In answer to this argument of the plaintiffs the court said:

"To give such a construction to the patent would subordinate the clear description contained in it of what are oils of the process, to an implied and vague description and classification which would leave the whole subject again at large, to become a field for further experimentation, without definition in the patent of what oils or froths would satisfy it. So interpreted the patent could not reasonably be said to contain a disclosure of the discovered process in the 'full, clear, concise, and exact terms' required by law [Rev. Stats., § 4888] and the claims might conceivably be said to fall short of 'particularly pointing out and distinctly claiming' any discovery at all within the meaning of the act of Congress."

This holding is a complete refutation of the statement in the patent in suit (No. 962,678) where it says that the frothing agents of the prior art are only such as are immiscible in water, to wit:

"In the frothing processes hitherto known the substances used to secure the formation of a mineral-bearing froth has been oil or an oily liquid immiscible with water."

It is not only a refutation of this statement of the patent in suit but an affirmation of the proposition that "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue," whether immiscible or soluble, or partly immiscible and partly soluble, are frothing agents within the meaning of the disclosure of patent No. 835,120, which is a disclosure of the art prior to the patent in suit.

Among the oils, fatty acids and other substances having the preferential affinity referred to in patent No. 835,120, are the tar products of the Cattermole prior art patent No. 777,273, and the fatty and resin acids and their derivatives, cresols and phenols, referred to in the Cattermole prior art patent No. 777,274, all of which substances have a preferential affinity for metalliferous matter over gangue.

Amyl acetate known in commerce as banana oil, and amyl alcohol commonly known as fusel oil, both of which are specifically mentioned as mineral-frothing agents in the patent in suit [No. 962,678], have a preferential affinity for metalliferous matter and are undoubtedly oils of the prior art. Amyl acetate is soluble in water in the proportions used of a fraction of one percent on the ore. Valerianic acid is a soluble mineral-frothing agent specifically named in the patent in suit and is a fatty acid of the prior art patents Nos. 835,120 and 777,274. Benzoic acid is also one of the soluble mineral-frothing agents specifically mentioned in the patent in suit. It has a preferential affinity for metalliferous matter over gangue and is therefore included within the terms referred to in patent No. 835,120 as "other substances" and is also included among the resin acids of Cattermole 777,274. Phenol and cresol named or referred to as soluble mineral-frothing agents in the patent in suit are specifically named in the prior art patent of Cattermole 777,274 and are among the oils or oily liquids of patent No. 835,120.

Phenol being among the oils or oily liquids of patent No. 835,120 and that patent having disclosed that by reducing the quantity used to a fraction of one percent on the weight of the ore and by vigorously agitating the pulp, the agent would effect the process of that patent, it is apparent that a clear disclosure anticipating the patent in suit is shown, for phenol in the quantity used in the process of that patent is wholly dissolved in water.

This construction of patent No. 835,120 is confirmed by the disclosure in the New Zealand patent No. 19,633 of October 27, 1905, which corresponds to the United States patent No. 835,120, and was granted to the same persons for the same invention. That patent was applied for June 27, 1905; and the language used in the first three pages of the specification is practically the same as in No. 835,120. On the fourth page of the patent (R. Vol. 3, p. 189) it is stated:

"Another feature of this invention consists in the method of producing and utilizing the fatty or resin acids or certain other aromatic derivatives (such as cresols, phenols, etc.)."

The next four paragraphs deal with what is known as the granulation process of the Cattermole patent, in which the agent used is in the proportion of one to four percent of the ore; but in the succeeding fifth paragraph this New Zealand froth agitation patent states:

"If, however, the proportion of fatty acids be less than 1% of the ore a greater or less proportion of the coated metalliferous matter will form into a froth as described at the beginning of this specification."

The words fatty acids as used in that paragraph refer back to the group of fatty acids and their derivatives cresol and phenol previously mentioned and plainly disclose that phenol is one of the frothing agents described in and made a part of patent No. 835,120; and if used in the fraction of one percent on the ore, the critical amount of the patent, the metalliferous matter will be coated and the froth formed.

The New Zealand patent like the United States patent does not undertake to limit the kind of frothing agent used to one that is immiscible in water and no where makes use of the term.

Then again, the disclosure of these two prior art patents,—that agents having a preferential affinity for metalliferous matter coat the mineral particles with a slight film,—is supported by the adsorption theory presented in evidence through defendant's witness Taggart, that such agents, though in solution, will attach themselves to and slightly coat the mineral particles.

The plaintiffs undertook to refute the disclosure of the New Zealand and the United States patents,—that a soluble agent would coat the metalliferous particles and on agitation produce a froth or scum,—by an experiment which they made; but the experiment amounted to nothing in the absence of the deduction drawn therefrom by the plaintiffs' expert witness, which deduction was contradicted and substantially refuted by the testimony of the defendant's witness.

As stated by the defendant's witness there is nothing mysterious about the dissemination of immiscible, or soluble agents in water. "It is just a question of the size of the particles into which the material that is added to the water is broken. If they are extremely small, so small that you

cannot see them, then it is solution. If they are larger, it is not solution. * * * In the case of the oleic acid we have particles there that are so fine that you cannot see them and we have other particles up and up to a size big enough to have been seen, if we had had clear water. When [in plaintiffs' experiments] they put that concentrate containing a lot of these particles of oleic acid that were not in solution onto the filter (which is just like a screen) those big particles of oleic acid would not go through the filter, and they were held back with the big particles of solid matter. Then, when that mixture was put back into the machine, those particles of oleic acid that had been held back went right ahead and functioned as they had in the first case, but they had not come off the mineral particles. They were there dispersed throughout the liquid. Now, when you put the phenol mixture on [the filter], the phenol particles were all dispersed so fine that they would go through the screen, so they went through. And there was still the phenol on the mineral particles, but as I testified before, that phenol that was on the mineral particles is held there so tight that when the mineral particles with it on are put back in the water there is none of it that comes off into the water to cause the frothing, to cause the stabilization of the bubbles that is necessary for the production of froth."

Furthermore, a study of the testimony in the case and the reason of the thing have convinced us that oleic acid (the agent specifically named in patent No. 835,120 and declared to be immiscible in the patent in suit) and all the mineral-frothing agents that have been used in these processes, in the limited amount prescribed of a fraction of one percent on the ore, are soluble to some extent because you can not get froth flotation unless there is present a constituent soluble to an extent sufficient to produce the requisite froth or scum, and the fact that oleic acid, when so used, produces the requisite froth or scum.

In the Miami Copper case, supra, the litigation involved both patent No. 835,120 and the patent here in suit No. 962,678. The agent employed by the defendant in its infringing process was partly soluble and partly insoluble, and the use of such an agent in a fraction of one percent on the ore was held to infringe both patents on the ground that it was a conjoint use of both. While such use was plainly

within the scope of the disclosure of the first patent (No. 835,120) and an infringement of it, it was not within the scope and an infringement of the second patent, for even assuming that the second patent is valid, its scope, as previously pointed out, is limited to the use of an agent that is wholly in solution in water. This being so, the use of the agent there employed was not within the scope and an infringement of the second patent. We, therefore, decline to follow the decision in the Miami case.

For the reasons above given we are of the opinion that the claims of the patent here in question are invalid and that the decree of the court below must be vacated.

The decree of the District Court is vacated and the case is remanded to that court with directions to enter a decree dismissing the plaintiff's bill with costs.

Anderson, J., concurs in the result.

On the same day, to wit, January 10, 1929, the following Final Decree was entered:

FINAL DECREE—January 10, 1929

This cause came on to be heard October 2 and 3, 1928, upon the transcript of record of the District Court of the United States for the District of Maine, and was argued by counsel:

Upon consideration whereof, It is now, to wit, January 10, 1929, here ordered, adjudged and decreed as follows: The decree of the District Court is vacated and the case is remanded to that court with directions to enter a decree dismissing the plaintiff's bill with costs.

By the Court.

Arthur I. Charron, Clerk.

CLERK'S CERTIFICATE

I, Arthur I. Charron, Clerk of the United States Circuit Court of Appeals for the First Circuit, certify that the three volumes, entitled as follows:

Volume I, Pleadings and Evidence and Proceedings in Circuit Court of Appeals;

Volume II, Plaintiff's Exhibits;

Volume III, Defendant's Exhibits;

this certificate being attached to each of said volumes, contain and are a true copy of the record and all proceedings to and including February 25, 1929, in said court numbered and entitled as follows: No. 2259, Magma Copper Company, Defendant, Appellant, v. Minerals Separation North American Corporation, Plaintiff, Appellee.

In testimony whereof I hereunto set my hand and affix the seal of said United States Circuit Court of Appeals for the First Circuit, at Boston, in said First Circuit, this twenty-fifth day of February, A. D. 1929.

Arthur I. Charron, Clerk. (Seal, United States Circuit Court of Appeals, First Circuit.)

SUPREME COURT OF THE UNITED STATES, OCTOBER TERM, 1928

No. —

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner,

vs.

MAGMA COPPER COMPANY, Respondent

On Petition for Certiorari to the United States Circuit Court of Appeals for the First Circuit

MOTION TO EXTEND PERIOD OF TIME WITHIN WHICH TO FILE APPLICATION FOR CERTIORARI HEREIN

To the Honorable the Associate Justice of the Supreme Court of the United States assigned to the First Circuit:

Now comes Minerals Separation North American Corporation, by its Attorneys, Henry D. Williams and Frederic D. McKenney, and respectfully prays that the time for filing application for certiorari to review decree of the United States Circuit Court of Appeals for the First Circuit entered in above entitled cause on the 10th day of January, 1929, may be extended, pursuant to authority provided in and by Section 8 (a) of the Act of Congress of February 13, 1925, 43 Stats. L. 936; U. S. Code, Title 28, sec. 350, for a period of time, not exceeding sixty days from the date of this application, viz, April 5, 1929.

As ground for such application for extension, applicant respectfully shows that the opinion and decree of the United States Circuit Court of Appeals for the First Circuit, complained of and intended to be brought under review was entered on the 10th day of January, 1929; that duly certified transcript of the record in the cause, which is of large proportion, aggregating more than 2,500 printed pages, was promptly applied for and was certified by the Clerk of said Circuit Court of Appeals for delivery to applicant on the 25th day of February, 1929; that same was at once lodged with the Clerk of the Supreme Court of the United States for final preparation and printing for use in the Supreme Court of the United States, and such

complete copies were made ready for distribution to counsel on March 18th, 1929.

Counsel for applicant have busily applied themselves to the preparation of necessary application for certiorari and supporting brief and same is now well advanced towards competition, but because of the character of the subject matter in controvesy, further consultation between such counsel is deemed necessary before final adoption.

The controversy between the parties to this cause involves questions as to the validity and alleged infringement of certain claims of United States Letters Patent No. 962,678, issued June 28, 1910, to Sulman, Greenway and Higgins, of London, England, and duly assigned by patentees to applicant here, Minerals Separation North American Corporation. The invention described is for "certain new and useful improvements in ore concentration" and having as its principal object "to separate certain constituents of an ore such as metal-ic sulfids from other constituents such a gangue when the ore is suspended in a liquid such as water."

The claims of the patent in issue are numbered 1 and 2.

In general aspect the process of ore concentration and recovery disclosed has heretofore been before this Court in the cases of:

Minerals Separation, Ltd. v. Hyde, 242 U. S. 261; and
Minerals Separation, Ltd. et al. vs. Butte & Superior Mining Co., 250 U. S. 336.

The precise patent and claims involved in the instant case were involved and adjudicated in favor of applicant by the Circuit Court of Appeals for the Third Circuit in Minerals Separation Limited v. Miami Copper Co., 244 Fed. 752.

In the instant case the Circuit Court of Appeals for the First Circuit expressly refused, for reasons set forth in its opinion and seriously contested by applicant, to follow the reasoning and conclusions of the Third Circuit Court of Appeals, saying in the course of its opinion, (30 Fed. (2d) at p. 69):

"Apparently they (applicant here) have obtained a decision to that effect, (i. e., holding inter alia claims 1 and 2 of patent 962,678 in suit to be valid and infringed) in

Miami Copper Co. v. Minerals Separation, Ltd., 244 Fed. 752."

In the course of such discussion the writer of the opinion in the instant case (Bingham, Cir. J.) opposed much of the reasoning in the opinion in said Miami case by arguments drawn from the learned judge's appreciation of the opinion of this Supreme Court of the United States (per Clark, Associate Justice) in Minerals Separation, Ltd. et al. vs. Butte & Superior Mining Company, 250 U. S. 336, a course of deductive reasoning which applicant respectfully contends was and is fallacious in that it proceeds, as applicant is advised and believes, upon a misapprehension in part and a misapplication in its entirety of the said opinion of this Court in said last mentioned case.

Wherefore applicant represents that its application for certiorari is founded upon an express conflict in decision respecting the identical subject matter between the United States Circuit Courts of Appeal for the Third and First Circuits, and upon an implied declination on part of the Circuit Court of Appeals for the Third Circuit to follow and abide by the reasoning, ruling and decision of this honorable Court as same are understood by this applicant and were understood by the learned Justices of the United States Circuit Court of Appeals for the Third Circuit in said case of Minerals Separation, Ltd., et al. vs. Butte & Superior Mining Company, above referred to.

Respectfully submitted.

Henry D. Williams, Frederic D. McKenney, Attorneys for Minerals Separation North American Corporation.

Upon consideration of the foregoing Motion, the period for filing Application for Certiorari in this cause is extended to and including the thirtieth day of April 1929.

Oliver Wendell Holmes, Associate Justice Supreme Court of the United States.

[Endorsed:] No. —. October Term, 1928. Supreme Court of the United States. Minerals Separation North American Corporation, Petitioner, vs. Magma Copper Company, Respondent. Motion to extend time within which to

file application for certiorari. McKenney, Flannery & Craighill, Hibbs Building, Washington, D. C.

[Endorsed:] File No. —. Supreme Court U. S., October Term, 1928. Term No. —. Minerals Separation North American Corporation, Petitioner, vs. Magma Copper Co. Motion and order extending time within which to file petition for certiorari. Filed April 6, 1929.

SUPREME COURT OF THE UNITED STATES

ORDER ALLOWING CERTIORARI—Filed May 20, 1929

The petition herein for a writ of certiorari to the United States Circuit Court of Appeals for the First Circuit is granted. And it is further ordered that the duly certified copy of the transcript of the proceedings below which accompanied the petition shall be treated as though filed in response to such writ.

SUPREME COURT OF THE UNITED STATES

STIPULATION RE TRANSCRIPT OF RECORD—Filed Sept. 14, 1929

Stipulation Relative to Title to Patent in Suit

The following stipulation is entered into to permit the omission from the Transcript of Record in the Supreme Court of the United States of the voluminous title documents.

The patent in suit, No. 962,678, was issued to the inventors on June 28, 1910, and thereafter by an assignment dated September 26, 1910, the title was conveyed to Minerals Separation, Limited, of London, formerly one of the plaintiffs. On July 8, 1913, the latter company conveyed to Minerals Separation American Syndicate (1913), Limited, of London, the entire beneficial interest in the patent in suit. On December 7, 1916, the latter company conveyed this beneficial interest to the plaintiff, Minerals Separation North American Corporation. On June 1, 1922, the full legal title to the patent in suit, and all right of action, claim and demand under it, were assigned directly by Minerals Separation Limited to the plaintiff, Minerals Separation North American Corporation.

Henry D. Williams, of Counsel for Petitioner. Merton W. Gage, of Counsel for Respondent.

New York, N. Y., September 12, 1929.

Stipulation Relative to Transcript of Record

It is hereby stipulated that the following parts of the Transcript of Record in the United States Circuit Court

of Appeals for the First Circuit be omitted from the Transcript of Record in this Court:

Vol. I, pp. 615-919, Depositions of Leslie Bradford and Theodore J. Hoover.

Vol. II, pp. 5- 36, Plaintiff's Exhibits 2-5.
pp. 97-234, Plaintiff's Exhibits 32-101.
pp. 428-630, Plaintiff's Exhibit E-I for identification, and plaintiff's Exhibits 112, 113.

Vol. III, pp. 1- 16, Defendant's Exhibits 1-12.
pp. 52- 83, " " 23-30.
pp. 112-117, " " 39.
pp. 123-156, " " 41-47.
pp. 159-169, " " 49-52.
pp. 222-251, " " 61-67.
pp. 255,256, " " 69.
pp. 282-289, " " 73, 74.
pp. 309-392, " " 80-94.
pp. 479-570, " " 118-120 (k).
pp. 593-654, " " 120-122 (o).
pp. 665-668, " " 124.
pp. 743-971, " " 133-140.

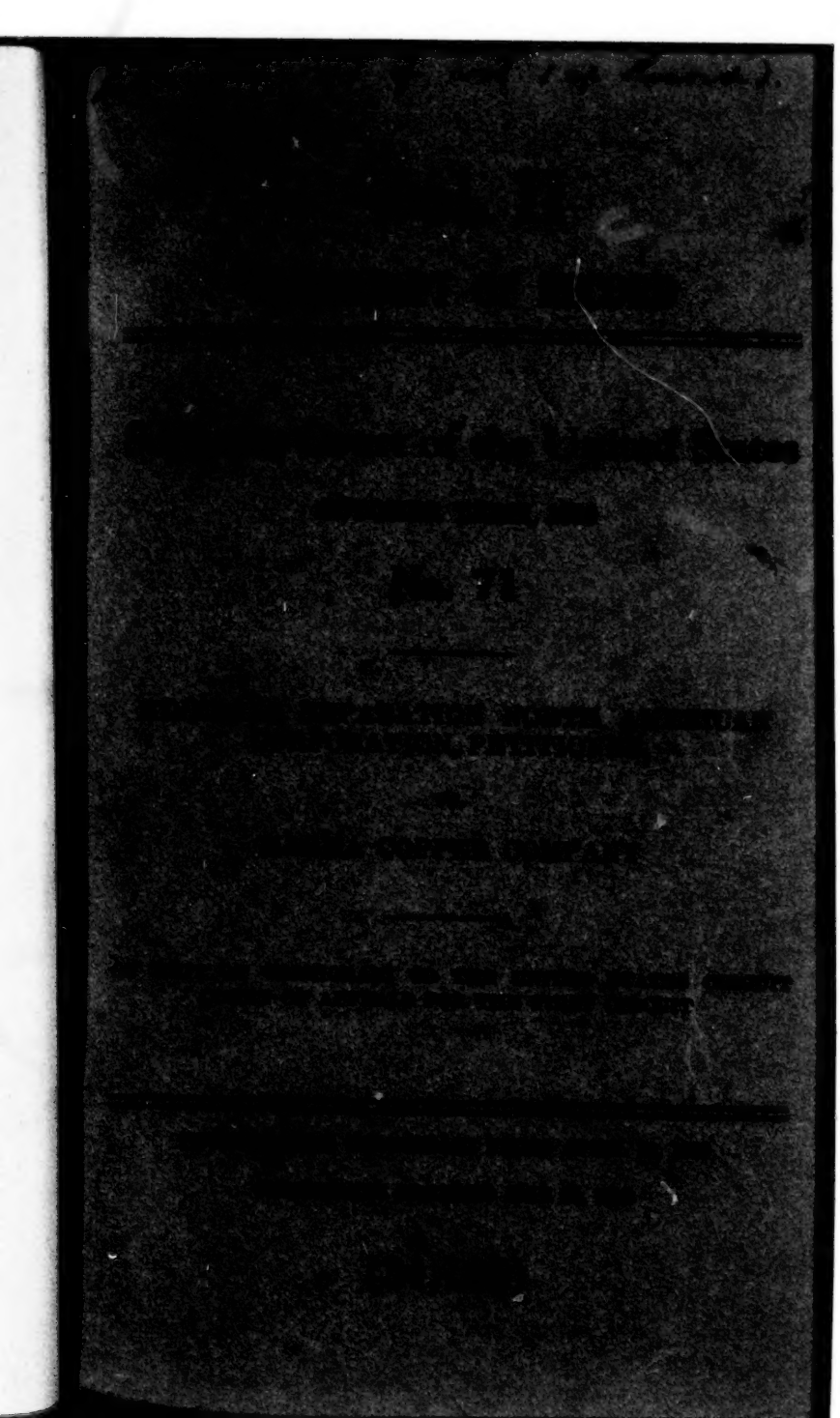
The following physical Exhibits are also excluded from the Record in this Court:

Plaintiff's Exhibits 82, 98, 100 and 101.

Henry D. Williams, of Counsel for Petitioner. Merton W. Gage, of Counsel for Respondent.

New York, N. Y., Sept. 12, 1929.

[File endorsement omitted.]



(34,160)

SUPREME COURT OF THE UNITED STATES

OCTOBER TERM, 1929

No. 71

MINERALS SEPARATION NORTH AMERICAN CORPORATION, PETITIONER,

vs.

MAGMA COPPER COMPANY

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FIRST CIRCUIT

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UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FIRST CIRCUIT.

OCTOBER TERM, 1927.

No. 2259.

MAGMA COPPER COMPANY,

DEFENDANT, APPELLANT,

v.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,

PLAINTIFF, APPELLEE.

APPEAL FROM THE DISTRICT COURT OF THE UNITED STATES
FOR THE DISTRICT OF MAINE,
FROM INTERLOCUTORY DECREE (PETERS, J.), APRIL 20, 1928.

TRANSCRIPT OF RECORD.

VOLUME II.

PLAINTIFF'S EXHIBITS.

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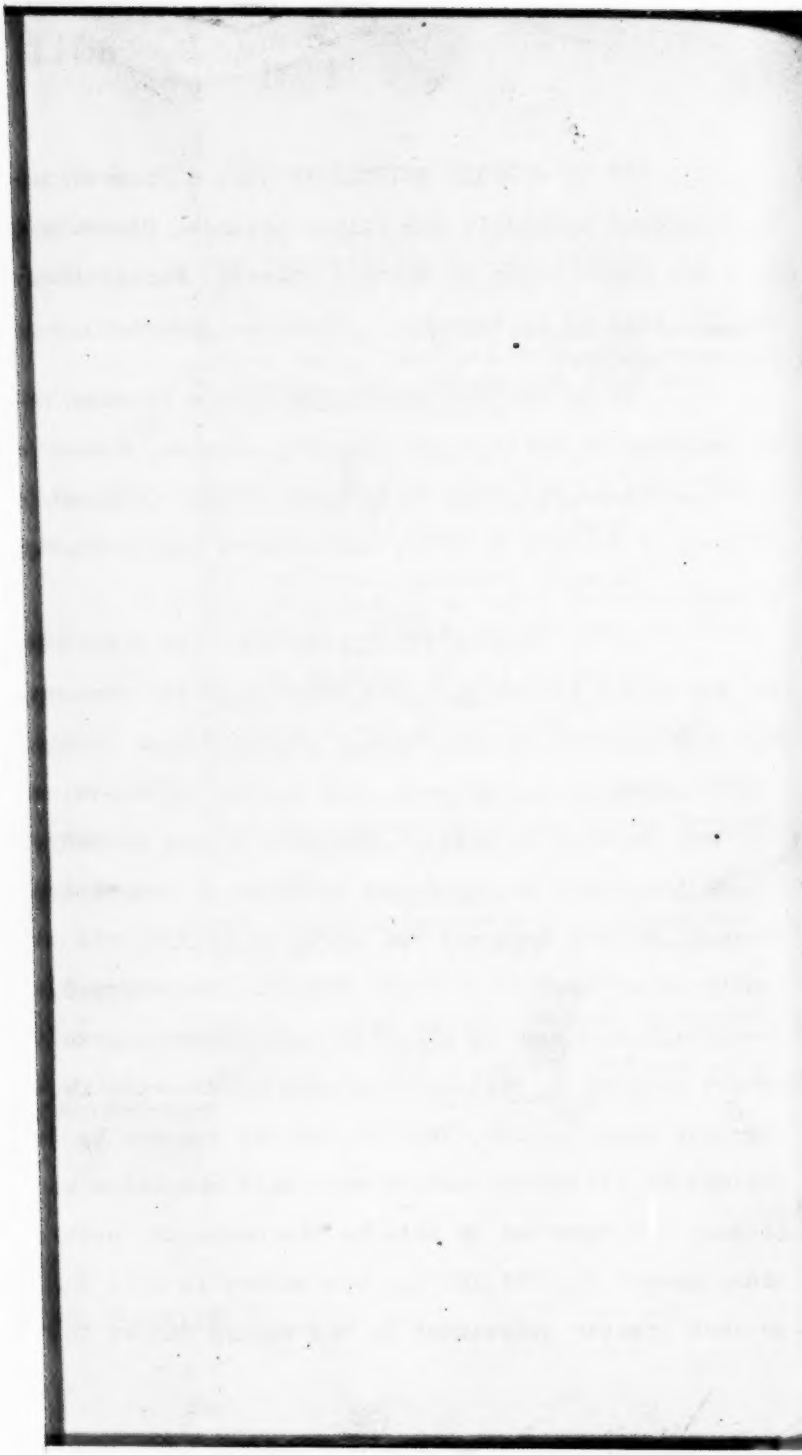
SIDNEY ST. F. THAXTER,
WILLIAMS, RICH & MORSE,
For Appellee.

COURT OF APPEALS
Clerk's Office
JUN 7 1928
FOR THE FIRST CIRCUIT



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CHARLES E. MC

Supreme Court of the United States

OCTOBER TERM, 1928

No. 71

MINERALS SEPARATION NORTH AMERICAN CORPORATION,

Petitioner,

—against—

MAGMA COPPER COMPANY,

Respondent.

PETITION FOR A WRIT OF CERTIORARI TO THE CIRCUIT COURT OF APPEALS FOR THE FIRST CIRCUIT AND BRIEF IN SUPPORT THEREOF.

HENRY D. WILLIAMS,
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LINDLEY M. GARRISON,
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Supreme Court of the United States

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner,

—vs.—

MAGMA COPPER COMPANY,
Respondent.

PETITION FOR WRIT OF CERTIORARI TO THE JUDGES OF THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FIRST CIRCUIT.

To the Honorable the Chief Justice and Associate Justices of the Supreme Court of the United States:

Your Petitioner, Minerals Separation North American Corporation, respectfully represents as follows:

I. In the instant case the Circuit Court of Appeals for the First Circuit

(1) has rendered a decision (30 Fed. (2d) 67, R. Vol. I, p. 943) in conflict with a decision of the Circuit Court of Appeals for the Third Circuit on the same matter (*Minerals Separation Limited* v. *Miami Copper Co.,* 244 Fed. 752), and

(2) has not given proper effect to applicable decisions of this Court (*Minerals Separation Limited* v. *Hyde,* 242 U. S. 261, and *Minerals Separation Limited* v. *Butte & Superior Mining Company,* 250 U. S. 336).

II. The instant suit is a suit in Equity begun January 9, 1920, in the United States District Court for the District of Maine, for infringement of United States Letters Patent, and was tried and decided as to infringement of claims 1 and 2 of United States Letters Patent No. 962,678, for a process of ore concentration granted June 28, 1910, to Sulman, Greenway and

Higgins and owned by your petitioner. The Circuit Court of Appeals for the First Circuit held the patent in suit, No. 962,678, claims 1 and 2, anticipated by a prior patent, No. 835,120, and invalid, expressly refusing to follow the Circuit Court of Appeals for the Third Circuit in the *Miami* case above referred to, which on substantially the same facts had held patent No. 962,678, claims 1 and 2, not anticipated by said prior patent No. 835,120, and valid and infringed. Accordingly, in the instant case, the decree in the District Court (which had followed the Circuit Court of Appeals for the Third Circuit in the *Miami* case) was reversed, Anderson, *C. J.*, concurring in the result (Opinion, R., Vol. I, p. 943; 20 Fed. (2d) 67), the decree of reversal being dated January 10, 1929 (R., Vol. I, p. 956). The time for filing this petition has been extended to and including April 30, 1929 (R., Vol. I, p. 960).

III. The suit in the Third Circuit above referred to, *Minerals Separation Ltd.* v. *Miami Copper Company*, was a suit in equity begun October 10, 1914, in the United States District Court for the District of Delaware for the infringement of United States Letters Patent including patent No. 835,120 and patent No. 962,678, claims 1, 2 and 12, and a third patent No. 1,099,699. The proofs there included substantially the same prior art against patent No. 962,678, claims 1 and 2, that is proved in the instant case. In the District Court there the patent No. 835,120 and patent No. 962,678, claims 1, 2 and 12, were by the Honorable Edward G. Bradford, *D. J.*, on September 29, 1916, held valid and infringed (237 Fed. 609; at 634-636 as to patent No. 962,678).

On appeal the Circuit Court of Appeals for the Third Circuit, on May 24, 1917, held the three patents there in suit valid and infringed as to some of the claims thereof, including patent No. 962,678, claims 1 and 2 (244 Fed. 752; at 770-774 as to that patent). The dissent expressed by Judge Buffington, *C. J.*, discussed only the question of infringement of patent No. 835,120 (244 Fed. 775-792).

IV. It is with this decision of the Circuit Court of Appeals for the Third Circuit in the *Miami* case that the decision

of the Circuit Court of Appeals for the First Circuit in the instant case is in conflict, as heretofore stated.

This conflict is explicitly admitted upon the face of the decision of the Circuit Court of Appeals for the First Circuit in the instant case. At page 948 of the Record (30 F. (2d) at 69) it is said by that Court,

> "apparently they [the plaintiffs] have obtained a decision to that effect [holding *inter alia* claims 1 and 2 of patent No. 962,678 valid and infringed] in *Miami Copper Company* v. *Minerals Separation, Limited,* 244 Fed. 752",*

and again on pages 955, 956, of the Record (30 F. (2d) at 72) that decision of the Circuit Court of Appeals for the Third Circuit is discussed and at the conclusion of the paragraph appears the statement

> "We, therefore, decline to follow the decision in the *Miami* case."

V. On December 11, 1916, this Court rendered a decision in *Minerals Separation, Ltd.* v. *Hyde* (242 U. S. 261), involving the validity of patent No. 835,120, in which this Court compared the process of that patent with prior art processes and differentiated and defined it and sustained the patent No. 835,120 (as to some of its claims) as valid and infringed, referring in its opinion to a prior decision of the House of Lords (as to the equivalent of the process of patent No. 835,120) in *Minerals Separation, Ltd., et al.* v. *British Ore Concentration Syndicate, Ltd.*, 27 R. P. C. 33, and quoting from the opinions in that case as to the nature of that process, as more particularly pointed out in the accompanying brief. This decision of this Court was rendered pending the appeal in the *Miami* case from the District Court to the Circuit Court of Appeals for the Third Circuit and prior to the argument of that appeal,

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* Unless otherwise indicated, bracketted portions and italicizing in quotations will be ours.

and it received careful and controlling consideration in the subsequent decision of that case.

VI. On June 2, 1919, this Court rendered a further decision as to patent No. 835,120 in *Minerals Separation, Ltd., et al.* v. *Butte & Superior Mining Co.*, 250 U. S. 336, in which this Court reconsidered and reaffirmed the validity of patent No. 835,120. No change was announced in that opinion in the view this Court took of the nature of the process of patent No. 835,120 (as pointed out in the accompanying brief). This Court there considered the scope of the claims of that patent for the purposes of specific new questions of infringement.

VII. The Circuit Court of Appeals for the First Circuit in the instant case referred in its opinion to the two decisions of this Court aforesaid but, your petitioner submits, misunderstood and misapplied them and, therefore, did not give proper effect to these applicable decisions of this Court, as pointed out in the accompanying brief.

VIII. The present invention of patent No. 962,678 has made possible (either when used alone as by the respondent here and others, or when conjointly used with the invention of patent No. 835,120, and, in the case of some ores, with the invention also of patent No. 1,099,699 of the *Miami* case) the concentration by froth-flotation of the *porphyry copper ores*, a great class of ores which were not amenable to concentration by any flotation process prior to the invention of the process of the patent in suit No. 962,678. Those porphyry copper ores are now, i. e., when concentrated by aid of the process of patent No. 962,678, the world's greatest source of copper. The present invention therefore represents a momentous and revolutionary forward step in the practical metallurgical art.

IX. Two other mining companies besides the defendant in the instant case, infringed the patent in suit without license and suits are now pending against those other companies and

those suits are held in abeyance pending the determination of the instant case, namely, *Minerals Separation North American Corporation* v. *St. Louis Smelting & Refining Co.*, in the District of Missouri, and *Minerals Separation North American Corporation* v. *National Lead Co.*, in the District of New Jersey.

X. Although the patent expired on June 28, 1927, the liability of the defendant for its continuing infringement from before the commencement of the suit on January 9, 1920, until the expiration of the patent, and the liability of the other two mining companies, defendants aforesaid, is in the aggregate a very substantial amount. The royalties which would have been payable to your petitioner on the infringing operations of the defendant in the instant case and on the infringing operations of the other two defendants named, had these three mining companies taken licenses and paid the established royalties, is roughly estimated by your petitioner's engineers as aggregating $500,000, this estimate not being based upon any evidence herein, since there have not yet been any proceedings in the accountings prayed for in the said three suits, but being submitted as a carefully considered statement of counsel. The profits due to the infringing operations of the said three mining companies are believed to be a very much larger amount.

Your petitioner is advised and believes and therefore asserts that the decree herein of the Circuit Court of Appeals of the First Circuit is erroneous and the matters and questions involved in said decision are of such gravity and importance that this Honorable Court should require the said cause to be certified to it for its review and determination, in conformity with the provisions of the Acts of Congress in such cases made and provided.

WHEREFORE, because of the gravity and importance of the questions involved and in the interest of uniformity of decision, your petitioner respectfully prays that a Writ of Certiorari may be issued out of and under the seal of this Honorable Court, directed to the Judges of the United States Cir-

cuit Court of Appeals for the First Circuit, commanding that Court to certify and send to this Court for its review and determination on a day certain to be therein named, a full and complete transcript of the record and all proceedings of the said Circuit Court of Appeals in the case lately depending therein entitled on its docket No. 2259, Magma Copper Company, Defendant, Appellant, vs. Minerals Separation North American Corporation, Plaintiff, Appellee, and that the said decree of the Circuit Court of Appeals for the First Circuit may be reversed by this Honorable Court, and that your petitioner may have such other and further relief in the premises as to this Honorable Court may seem meet and just.

And your petitioner will every pray.

New York, N. Y., April 22, 1929.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
By HENRY D. WILLIAMS,
WM. HOUSTON KENYON,
LINDLEY M. GARRISON,
SIDNEY ST. F. THAXTER,
FREDERIC D. MCKENNEY,
Counsel for Petitioner.

SUPREME COURT OF THE UNITED STATES.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner,
—vs.—
MAGMA COPPER COMPANY,
Respondent.

BRIEF IN SUPPORT OF PETITION FOR WRIT OF CERTIORARI.

The first ground of the accompanying petition, conflict of decision between different Circuit Courts of Appeal on the same matter, sufficiently appears from the facts stated in the petition. The second ground, failure to give proper effect to applicable decisions of this Court, will now be considered, with explanation and quotation.

In the two applicable decisions of this Court, *Minerals Separation Limited* v. *Hyde*, 242 U. S. 261, and *Minerals Separation Limited* v. *Butte & Superior Mining Company*, 250 U. S. 336, the patent in suit was No. 835,120 to Sulman, Picard & Ballot, of November 6, 1906. In the instant case the patent in suit is No. 962,678 to Sulman, Greenway & Higgins, of June 28, 1910.

The two processes of the two patents (No. 835,120 of 1906 and No. 962,678 of 1910) are alike in aim (i. e. the concentration of ore) and in practical manipulation (i. e. the agitation and aeration of a so-called pulp consisting of water and the finely ground ore) and in the outward and tangible result (i. e. a mineral-bearing froth resting upon the surface of the pulp), but they are unlike in regard to the kind of frothing agent employed and in regard to its mode of operation in producing the mineral-bearing froth.

The process of patent No. 835,120 employed as the agent a fraction of one per cent of oil or other material having a

preferential affinity for the metalliferous particles submerged in the pulp, which agent in consequence of the agitation thinly coated the metalliferous particles and did not at all coat the gangue particles. It was on this preferential coating that the separation depended, for only the coated particles were picked up by the air bubbles (introduced by the agitation or otherwise) and lifted up out of the pulp in the form of a froth which could be separated.

The process of patent No. 962,678 employed as the agent a different class of materials, to wit, materials that went into solution in the water of the pulp and so modified the water that the air bubbles in the pulp preferentially picked up the uncoated metal particles (and not the gangue) and lifted them up out of the pulp in the form of a froth which could be separated. The process of patent No. 962,678 proceeded without any coating of the metalliferous particles, which coating was of the essence of the process of patent No. 835,120.

A typical claim of patent No. 835,120 of those sustained by this Court is the following (R. Vol. III, p. 181):

> "12. The process of concentrating powdered ore which consists in separating the minerals from gangue *by coating the minerals with oil in water* containing a fraction of one per cent of oil on the ore, agitating the mixture to cause the oil-coated mineral to form a froth, and separating the froth from the remainder of the mixture." *

Claim 1 of patent No. 962,678 in suit is as follows (R. Vol. II, p. 3):

> "1. The herein described process of concentrating ores which consists in mixing the powdered ore with *water containing in solution* a small quantity of a mineral frothing agent, agitating the mixture to form a froth and separating the froth."

We turn now to the two decisions of this Court with respect to patent No. 835,120.

---

* Unless otherwise indicated, bracketted portions and italicizing in quotations will be ours.

In the case of *Minerals Separation Limited* v. *Hyde,* 242 U. S. 261, this Court compared the process of patent No. 835,120 with prior art processes and distinguished it from them and held it patentably novel, referring in the course of its opinion (p. 269) to a prior decision of the House of Lords dealing with the same process in *Minerals Separation, Ltd. et al* v. *British Ore Concentration Syndicate, Limited,* 27 R. P. C. 33, stating agreement therewith and quoting from some of the opinions of the Law Lords as to the nature of the process. In the opinions in the House of Lords so quoted and throughout the opinion of this Court in the *Hyde* case reference is made to the preferential affinity of the agent used for the metalliferous matter over the gangue and to the coating of the metalliferous particles by the agent while the gangue particles remained uncoated (242 U. S. 261 at 263, 267, 269). This Court pointed out that while the preferential coating was old in earlier oil concentration processes the thinness of the oil coating was new and the lifting by the buoyancy of air was new and the resultant mineral-bearing froth was new.

In the *Butte & Superior* case this Court again reviewed the question of validity of patent No. 835,120 and said (250 U. S., at 339):

> "we see no reason for modifying our former conclusion."

Going to the new infringement questions before it and considering the *quantity* limitations of the claims of No. 835,120, this Court held as to the broader claims there involved that (pp. 341, 342):

> "the patent extends to and covers the use in the process of oils of the patent, in amounts equal to any fraction of one per cent. on the ore"

and reversed the holding of the Circuit Court of Appeals of the Ninth Circuit in that case to the effect that the use of a fraction of oil that was over one-half of one per cent. was not an infringement.

Considering the *quality* limitations of the claims—what the "oily liquid," the "oily substance," the "oil" of the claims was, to which the quantity limitation should be applied,—this Court held, affirming the Circuit Court of Appeals for the Ninth Circuit in that regard, that it included the petroleum products (fuel oil and kerosene) that had been employed by the defendant in a quantity making the whole greater than one per cent. on the ore, and of which this Court said (at p. 343):

> "It is admitted that petroleum products are 'oils having a preferential affinity for metalliferous matter.'"

Coming "to consider the nature and extent of the disclosures of the patent in suit [No. 835,120], but only with respect to the kinds and quantities of oil which may be used in the process" (at p. 346), this Court analyzed the specification and quoted from it as the "essence of the discovery" (*ib.*):

> "'We have found that if the proportion of oily substance be considerably reduced, say to a fraction of one per cent. on the ore, granulation ceases to take place, and after vigorous agitation there is a tendency for a part of the *oil-coated metalliferous matter* to rise to the surface of the pulp in the form of a froth or scum'"

and referred to an additional statement of the specification found in the description of the example of the application of the invention which statement this Court paraphrased as follows (at p. 347):

> "that the 'froth or scum' derives its power of flotation mainly from the inclusion of air-bubbles introduced into the mass by agitation, *such bubbles or air-films adhering only to the mineral particles which are coated with oleic acid.*"

Then after considering the claims this Court said (at p. 348):

> "From this consideration of the terms of the patent as written, it is apparent that it makes no differentiation whatever, either in the claims or in the specification, among the oils having a preferential affinity for

> metalliferous matter, and that its disclosure, to which the petitioners must be limited, is, that when a fraction of one per cent. on the ore of any such oil is used in the manner prescribed, there will be produced a metal-bearing froth, the result of the process."

It seems clear that this repeated and reaffirmed the decision in the *Hyde* case as to the nature of the process of patent No. 835,120 and particularly that it involved *coating the minerals* under the water of the pulp with the oil of the patent:

> "*coating* the minerals with oil in water containing a fraction of one per cent. of oil on the ore, agitating the mixture to cause the *oil-coated* mineral to form a froth" (claim 12 of No. 835,120, R., Vol. III, p. 181).
>
> "agitating the mixture until the *oil-coated* mineral matter forms into a froth" (claims 1, 2 and 3, R., Vol. III, p. 180).
>
> "agitating the mixture until the oleic acid has been brought into *efficient contact* with the mineral and has formed a froth therewith" (claims 5, 6 and 7, *ib.*).

Nevertheless the Circuit Court of Appeals in the instant case said of the decision of this Court in the *Butte & Superior* case (R. Vol. I, p. 952; 30 F. (2d) at 71):

> "This holding is a complete refutation of the statement in the patent in suit (No. 962,678) where it says that the frothing agents of the prior art are only such as are immiscible in water, to wit,
>
> > 'In the frothing processes hitherto known the substances used to secure the formation of a mineral-bearing froth has been oil or an oily liquid immiscible with water.' "

The error in this interpretation of the holding of this Court is emphasized by the contrasting opinion of the District Court in the instant case which has been reversed, wherein it is said (R. Vol. I, p. 924):

> "I consider that the decisions of the Supreme Court in the *Hyde* case and in the *Butte* case, above mentioned, are in harmony with the position of the plaintiff rather than with that of the defendant. The Court evidently regarded the first patent [No. 835,120] as a process patent limited to the use of oil or oily substances. In the *Butte* case, involving the first patent, the Court confirmed to the patentees their process claims involving the use of any of the class of oily (insoluble) mineral-frothing agents that acted by preferential affinity in coating the mineral. By implication it confirms to the patentees here their process claims involving the use of any of the class of soluble mineral-frothing agents that act on the different principle of going into solution, not coating the mineral, but modifying the water in some unknown way, to accomplish the same result in the end, i. e., bringing up to the surface the mineral particles attached to the froth."

The discovery and invention of patent No. 962,678 in suit was, as stated heretofore and in claims 1 and 2 in issue, a process of concentrating ores by agitating the powdered ore "with water containing *in solution* a small quantity of mineral-frothing agent * * * to form a froth"

or as the specification says (R., Vol. II, p. 3, ll. 61-64):

> "According to this invention the mineral-frothing agent consists of an organic compound contained *in solution* in the acidified water."

This process was founded upon a true discovery—the discovery of a new and different class of mineral-frothing agents.

An agent capable of existing "in solution" in the water of the pulp and thereby on agitation achieving mineral-froth formation and ore concentration, is and must be a different physical thing from an agent capable of existing as a coating on the metalliferous matter under the water of the pulp and thereby on agitation achieving mineral-froth formation and ore concentration.

The agents are and must be different to develop and operate by the contrary and inconsistent qualities stated, and the operations that proceed in the pulp are and must be different.

The disclosure of a process of concentrating ore

> "*by coating* the minerals with oil and water containing a fraction of one per cent. of oil on the ore, agitating the mixture to cause the *oil-coated* mineral to form a froth, and separating the froth from the remainder of the mixture" (claim 12 of No. 835,120, R., Vol. III, p. 181)

is manifestly not a disclosure of a process of concentrating ore by

> "mixing the powdered ore with water containing *in solution* a small quantity of a mineral-frothing agent, agitating the mixture to form a froth and separating the froth" (claim 1 of No. 962,678, R., Vol. II, p. 3).

The relation between coating and preferential affinity and the lifting force of air is that the preferential affinity causes the oil to preferentially coat the mineral particles under the water of the pulp (and not the gangue particles) and such coating causes the air bubbles to preferentially pick out and lift the mineral particles (and not the uncoated gangue particles) into a froth floating upon the surface of the pulp. Inevitably the agent that coats under water must to that end be insoluble, that is, immiscible, in the water. An agent that dissolved in the water could not exist as a coating on anything in that water.

The fact that complex manufactured products exist (like pine oil, for example) which are constituted in part of mineral-frothing agents that are immiscible in the water of the pulp and so are adapted to preferentially coat the metalliferous matter, and in part of mineral-frothing agents that dissolve in the water of the pulp and so are unable to coat anything in the pulp, does not alter or complicate the situation. Either constituent of such a substance if separated and used alone would achieve a froth-flotation process, the one by the principle of operation of patent No. 835,120 (if used in sufficiently small quantity) and the other by the principle of operation of patent No. 962,678; and if the complex sub-

stance were used without separation of its constituent elements both processes would simultaneously proceed and it would be a conjoint use of the two. The holding by this Court in the *Butte & Superior* case that the use of pine oil constituted an infringement of the broad claims of patent No. 835,120 did not constitute or imply a holding that that use might not also at the same time constitute an infringement of the later patent No. 962,678 for the other process, nor did it constitute or imply a holding that the two processes were really one, or that the patent for the first process anticipated the patent for the second. That question of anticipation of patent No. 962,678 by patent No. 835,120 did not arise, and was not before this Court, in the *Butte & Superior* case. This Court in that case did not, we believe and submit, either directly or indirectly pass upon that question or criticize or disapprove the decision of the Circuit Court of Appeals for the Third Circuit in respect to it. That decision of the Circuit Court of Appeals in the *Miami* case was before this Court for it is cited in the margin in the *Butte & Superior* opinion, as the last decision in the list referred to in the text, as follows (250 U. S., at 338):

> "The patent [835,120] has been so frequently described in Court proceedings,[1] that it will suffice to say of it here * * *."

These are not words of disapproval but rather of approval.

Nothing in the opinion of this Court in the *Butte & Superior* case gives support, we believe and submit, to the suggestion that this Court in that case intended to reverse or criticize or disapprove the description given of the process of patent No. 835,120, by the Circuit Court of Appeals for the Third Circuit in the *Miami* case, or the holding there made as to its bearing on patent No. 962,678.

Nothing in the decision of this Court in the *Butte & Superior* case required the Circuit Court of Appeals for the First Circuit in the instant case, as we believe and submit, to find claims 1 and 2 of patent No. 962,678 anticipated by patent No. 835,120.

Nothing in the decision of this Court in the *Butte & Superior* case, as we believe and submit, refuted the statement of the patent in suit No. 962,678 (R., Vol. II, p. 3, l. 58) as to the process of the prior patent No. 835,120:

> "In the frothing processes hitherto known the substances used to secure the formation of a mineral-bearing froth has been oil or an oily liquid immiscible with water"

because manifestly in order to *coat* the minerals with oil under water ("to cause the *oil-coated* mineral to form a froth" in accordance with the disclosure and the claims of patent No. 835,120) the oil or oily liquid must be "immiscible" with water.

It is submitted, therefore, that there is here not only (1) **a conflict of decision between two Circuit Courts of Appeals on the same matter,** but that (2) the Circuit Court of Appeals for the First Circuit in the instant case **has not given proper effect to applicable decisions of this Court,** to wit, the decisions above referred to in the *Butte & Superior* case and in the *Hyde* case.

New York, N. Y., April 22, 1929.

Respectfully submitted,

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SIDNEY ST. F. THAXTER,
FREDERIC D. McKENNEY,
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CHARLES ELMO

Supreme Court of the United States

October Term, 1928.

No. [redacted] 71

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner,

—vs.—

MAGMA COPPER COMPANY,
Respondent.

REPLY BRIEF FOR PETITIONER ON PETITION FOR WRIT OF CERTIORARI.

The brief for respondent sets forth as findings of fact, as though made by the trial Court, the opinions on matters of theory adopted by a majority of the Appellate Court. The so-called "facts" of Point 1 of Brief for Respondent are not facts in the legal sense but are "theories" developed to meet the exigencies of the case. They deal with magnitudes as negligible for all practical purposes as the statement that glass is soluble in water (R., Vol. 1, p. 357, XQ. 72). The District Court dealt wisely with these theories (R., Vol. 1, p. 923, last paragraph, and following page). It is submitted that the essential facts as to the subject matter decided by the First Circuit Court of Appeals in the instant case are substantially the same as in the case decided by the Third Circuit Court of Appeals. The same processes were under consideration and substantially the same documents describing these processes.

On page 11 of Brief for Respondent, as printed, there is a misquotation from the decision of this Court in the *Butte & Superior* case. This misquotation, appearing on lines 13 and 14, is as follows:

> "non-frothing oils (immiscible, if such there are) having the required affinity."

The words within the parentheses are not in the decision of this Court, and further, even as an interpolation, are unjusti-

fied. The attention of respondent's counsel was immediately called to the misquotation and it was said by them that the parentheses would be changed to brackets, and this has probably been done by way of correction. Nevertheless the interpolation is wholly unjustified. The error probably arose through an erroneous quotation from the decision of this Court in the opinion of the Circuit Court of Appeals for the First Circuit. This Court said in the opinion in the *Butte & Superior* case (250 U. S. at 249, 250) discussing the contention of the plaintiffs-petitioners in that case that the highly immiscible and insoluble petroleum oils were not frothing oils and not within the claims:

> "It is argued that the provision of the claims that the mixture prescribed, of oil, water, and ore, shall be agitated until the oil-coated mineral matter forms into a froth, serves to differentiate the 'frothing oils' from others having the required preferential affinity for metalliferous matter, but which, when agitated in the mixtures, may not produce the characteristic froth, if any such there are, and that a proper construction of the patent limits it to such 'frothing oils,' and renders the use of them in a fraction of 1 per cent on the ore an infringement when used with 'non-frothing oils' having the required affinity in amounts sufficient to make the combination exceed the quantity limit of the patent."

In the opinion of the Circuit Court of Appeals for the First Circuit (Vol. I, p. 951, last paragraph, continued on p. 952) this paragraph was broken up into two quotations and from the second of these quotations essential words were omitted and to it unjustified interpolations were added. At page 951, line 7 from the bottom, the words "for metalliferous matter" after "affinity" were omitted. In line 5 from the bottom the words "if any such there are," following the word "froth," were omitted from the quoted part and inserted in the interpolation, but were preceded there by the word "immiscible." The same unjustified interpolation was repeated on the bottom line of page 951 and top line of page 952.

What this Court said referred to oils having the required preferential affinity for metalliferous matter which might not produce the characteristic froth. By the erroneous quotation and interpolations this was changed to indicate a doubt expressed by this Court as to the immiscibility of these highly immiscible and insoluble petroleum oils. No such doubt was expressed by this Court.

Respondent's Brief (p. 11, ll. 13, 14) gives the quotation first above stated as from the decision of this Court repeating the same unjustified interpolation, and thus erroneously presents the conclusions of this Court expressed in the *Butte & Superior* case.

It is deemed advisable to submit the foregoing in order that the Court may not be left with the impression that petitioner admits the statements or deductions set forth in Respondent's Brief. Petitioner submits, however, that such matters are for consideration of the Court on the merits when the Petition for Certiorari shall have been granted and the case docketed in this Court.

New York, N. Y., May 10, 1929.

Respectfully submitted,

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Supreme Court of the United States

October Term, 1929

No. 71

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner-Plaintiff,

—vs.—

MAGMA COPPER COMPANY,
Respondent-Defendant.

BRIEF FOR PETITIONER-PLAINTIFF

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Magma Copper Company v. Minerals Separation North American Corporation C. C. A., 1st, 30 F. (2d) 67, R. Vol. I, p. 639.

Supreme Court of the United States

OCTOBER TERM 1929.

No. 71.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner-Plaintiff,
—vs.—
MAGMA COPPER COMPANY,
Respondent-Defendant.

BRIEF FOR PETITIONER-PLAINTIFF.

GENERAL STATEMENT.

This is a suit in equity originating in the District of Maine for infringement of Letters patent No. 962,678, claims 1 and 2.

The Circuit Court of Appeals for the First Circuit (Bingham and Johnson, *C. Js.*) held the patent anticipated by plaintiff's earlier patent No. 835,120 and directed that the Bill be dismissed (Anderson, *C. J.* concurring in the result) (R. Vol. I, p. 639, 30 Fed. [2d] 67), refusing to follow the contrary decision of the Circuit Court of Appeals for the Third Circuit in *Minerals Separation, Ltd.* v. *Miami Copper Company,* 244 Fed. 752.

The Circuit Court of Appeals for the Third Circuit in the said *Miami* case had followed this Court in this Court's elucidation in *Minerals Separation, Ltd.* v. *Hyde,* 242 U. S. 261, of the invention of plaintiff's earlier patent aforesaid No. 835,120 (an elucidation later confirmed by this Court in *Minerals Separation, Ltd.* v. *Butte & Superior Mining Co.,* 250 U. S. 336), reaching in consequence its conclusion that the patent in suit No. 962,678, claims 1 and 2, was not anticipated by patent No. 835,120, and was valid and infringed.

The documents compared were the same in the two cases and the proofs there included substantially the same prior art against patent No. 962,678, claims 1 and 2, that is presented in the instant case.

The Circuit Court of Appeals for the First Circuit in the instant case (or a majority of that Court) refused to accept and follow the said decisions of this Court as to the nature of the invention of the earlier patent No. 835,120 and disregarded and over-rode those decisions, reaching in consequence thereof its majority conclusion that the patent in suit No. 962,678 was anticipated by patent No. 835,120.

Petition for Writ of Certiorari was granted May 20, 1929 (R. Vol. I, p. 659).

The jurisdiction of this Court rests upon the Judicial Code.

ARGUMENT.

The opinion of the Circuit Court of Appeals in the instant case deals only with one defense, namely, the defense of alleged anticipation of the patent in suit No. 962,678 by patent No. 835,120. It does not deal with the other defenses that were argued by the defendant in both Courts and overruled by the District Court. We shall therefore discuss in this brief the defense of alleged anticipation of the patent in suit No. 962,678 by patent No. 835,120, as to which the two Circuit Courts of Appeals for the First and for the Third Circuits are in conflict.

The issue of fact on which the two Circuit Courts of Appeals are in conflict (namely, whether patent No. 835,120 anticipates patent No. 962,678) turns on the nature of the invention of the earlier patent No. 835,120, and as to that this Court has authoritatively spoken.

To briefly define the issue:

Both patents concentrate ore by mineral-froth flotation.

Both utilize the lifting force of air bubbles to raise the mineral particles into the form of a froth lying on the top of the pulp.

They differ as to the agent and the principle by which that lifting force is made to select the mineral particles in prefer-

ence to the gangue particles and as to characteristics of the mineral-bearing froth produced.

Patent No. 835,120 employs *an oil or oily substance* as the agent, oleic acid being the one example given. This oil or oily substance by reason of its preferential affinity for mineral particles over gangue particles (well known long before patent No. 835,120) oil-coats the mineral particles in preference to the gangue and if the oil quantity is minute enough (a fraction of one per cent on the ore) a mineral froth results from aeration and agitation and rises through and out of the pulp, the froth carrying the oil-coated mineral particles.

Patent No. 962,678 employs a mineral-frothing agent that dissolves in the water of the pulp and therefore does not and cannot coat the mineral particles, preferentially or otherwise, but so modifies that water that upon aeration and agitation a mineral froth results and rises as before, carrying the uncoated mineral particles.

The Circuit Court of Appeals for the First Circuit in the instant case nevertheless found patent No. 962,678 anticipated by patent No. 835,120 on the unproved and indeed disproved hypotheses that the agent in solution of patent No. 962,678 really also coats the mineral particles and that the coating agent of patent No. 835,120 really also goes partly or wholly into solution and that that solution really produces the froth, and that both therefore act on the same principle and are the same process.

But that Court disregarded the fact proved that the alleged coating of mineral particles by the agent in solution of patent No. 962,678 was not a coating at all but was at most a negligible increase or decrease in the strength of the solution wherever the solution came in contact with any surface, either a mineral surface, a gangue surface, an air surface, or a tank bottom or wall surface. An increase in the strength or concentration of the solution at a surface is known as "positive adsorption" and a decrease or dilution as "negative adsorption." It was proved that there was no relation whatsoever between the adsorption phenomena and the carrying on of the process of the patent in suit, No. 962,678, since the process was carried on

whether the adsorption was positive or negative, and could be carried on with some soluble substances that produced positive adsorption and could not be carried on with other soluble substances that produced positive adsorption; and it was not proved that adsorption acted preferentially at any surface.

And that Court also disregarded the fact, admitted by defendant's experts, that the solubility of the oleic acid of patent No. 835,120 in the water of the pulp was of the same order as the solubility of window glass in rain water and was altogether negligible in the process of patent No. 835,120.

In all this the Circuit Court of Appeals for the First Circuit proceeded upon speculative theories propounded by defendant's experts, unproved and in fact disproved, and disregarded the simple description that this Court had given of the process of patent No. 835,120 and the definition that this Court had given of the "oils or oily substances" of that patent.

Patent No. 835,120 was before this Court on two occasions. On the first occasion (the *Hyde* case, *supra*) for novelty, utility and validity; on the second occasion (the *Butte & Superior* case, *supra*) for determination of the scope of claims on a question of infringement which turned on the definition given to the "oils and oily substances" of that patent.

This Court in the *Hyde* case quotes from patent No. 835,120 (242 U. S. 263):

> "the object being to separate metalliferous matter, graphite, and the like from gangue by means of oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue."

It then interprets that language as follows (242 U. S. 264):

> "It is clear that in the prior art, as it is developed in this record, it was well known that oil and oily substances had *a selective affinity or attraction for, and would unite mechanically with,* the minute particles of metal and metallic compounds found in crushed or powdered ores, but would not so unite with the quartz, or rocky non-metallic material, called 'gangue.' Haynes British patent (1860), and United States patents, Ever-

son (1886), Robson (1897) and Elmore (1901). It was well known that *this selective property of oils and oily substances* was increased when applied to some ores by the addition of a small amount of acid to the ore and water used in process of concentration. United States patents, Everson (1886), Elmore (1901), and Cattermole (1904)."*

Then this Court says (242 U. S. 267) after describing in detail the discovery of the process of patent No. 835,120 in the course of experiments with oleic acid as the agent in a Cattermole metal-sinking process:

> "It was promptly recognized by the patentees that this froth [of the process of No. 835,120] was not due to the liberation of gas in the mass treated by the action of the dilute acid used [chemical action] and its formation was at once attributed in large part to the presence of the air introduced into the mixture by the agitation which had been resorted to to mix the oil with the particles of crushed ore, which air, in bubbles, attached itself to the mineral particles, *slightly coated as they were with what was necessarily an infinitesimal amount of oil,* and floated them to the surface."

And later after stating agreement with the decision of the House of Lords in *Minerals Separation* v. *British Ore Concentration Syndicate, Ltd.*, this Court quoted from that decision as follows (242 U. S. 269):

> "And Lord Atkinson said: 'In their process this *mysterious affinity of oil for the metallic particles* of the ore is availed of, yet the oil is used in such relatively infinitesimal quantities *that the metallic particles are only coated with a thin film of it,* and the lifting force is found not in the natural buoyancy of the mass of added oil, but in the buoyancy of air bubbles, which, introduced into the mixture by the more or less violent agitation of it, envelop or become attached to, *the thinly*

* Unless otherwise indicated, bracketted portions and italicizing in quotations will be ours.

> *oiled metallic particles,* and raise them to the surface, where they are maintained by what is styled the surface tension of the water'."

In the *Butte & Superior* case this Court reviews the prior proceedings and quotes portions of its prior decision, and says (250 U. S. 341, 342):

> "the language quoted seems to indicate clearly enough that the opinion of the court then was, as it is declared now to be, that as to the claims here involved the patent *extends to and covers the use in the process of oils of the patent, in amounts equal to any fraction of one per cent.* on the ore."

This, it will be noted, introduces the term "oils of the patent" which is repeated many times in the decision and which is repeatedly held to mean "oils having a preferential affinity for metalliferous matter," as stated in the specification of the patent.

Then this Court considers the question "whether petroleum products or derivatives used by the respondent were oils within the scope of the patent" and remarks (250 U. S. 343):

> "It is admitted that petroleum products are 'oils having a preferential affinity for metalliferous matter'."

and in the course of its reasoning says (250 U. S. 349):

> *"the only disclosure* as to the kind and amount of oil which the patentees made to the public as necessary to the practicing of their process is that it must be an oil or oily substance, or oily liquid having a *'preferential affinity for metalliferous matter,'* and that it shall be limited in amount 'to a fraction of one per cent. on the ore'."

It is therefore clear that this Court has decided, as to the "kind of oil," that patent No. 835,120 discloses

> "that it must be an oil or oily substance, or oily liquid having a *'preferential affinity for metalliferous matter',"*

to the end that it may *preferentially coat that metalliferous matter* and thereby determine its predominance in the froth and the ore concentration achieved by that predominance.

The Circuit Court of Appeals for the Third Circuit in the *Miami* case having both patents before it, No. 835,120 and No. 962,678, and the decision of this Court in the *Hyde* case, said of patent No. 962,678, the patent here in suit (244 Fed. 771), after considering patent No. 835,120 and its validity:

> "It is also an air-froth flotation process, but differs from the first patent, although both processes may be, and both actually are, employed conjointly. Its essential feature is the use of a mineral-frothing agent in solution."

Later that Court said (244 Fed. 773):

> "The difference between the two patents may be shortly stated to be this: The first process rests upon the use in very small quantity of an oily substance that does not dissolve in water, coupled with agitation of the pulp, and this succeeds in producing a special froth that is remarkably effective in recovering the minute particles of ore. The second process does not employ oil, or an undissolvable substance; on the contrary, the 'mineral-frothing agent' must be in solution, and *ex vi termini* must therefore be dissolvable. * * *
>
> "We do not find it necessary to discuss the question of validity; our conclusion is, that the patent discloses invention and has not been anticipated. As in the case of the oil process, the patentees seem to have taken 'the final step which converted experiment into solution, turned failure into success.' *Minerals Separation Co.* v. *Hyde,* 242 U. S. 261, 37 Sup. Ct. 82, 61 L. Ed. 286. And we find nothing in the prior art that can be held to anticipate."

In this situation the District Court in the instant case said of the two decisions of this Court (Vol. I, pp. 620, 621):

> "I consider that the decisions of the Supreme Court in the *Hyde* case and in the *Butte* case, above mentioned, are in harmony with the position of the plaintiff rather

> than with that of the defendant. The Court evidently regarded the first patent as a process patent limited to the use of oil or oily substances. In the *Butte* case, involving the first patent, the Court confirmed to the patentees their process claims involving the use of any of the class of oily (insoluble) mineral-frothing agents that acted by preferential affinity in coating the mineral. By implication it confirms to the patentees here their process claims involving the use of any of the class of soluble mineral frothing-agents that act on the different principle of going into solution, not coating the mineral, but modifying the water in some unknown way, to accomplish the same result in the end, *i.e.*, bringing up to the surface the mineral particles attached to the froth."

and again (R. Vol. I, p. 621):

> "It seems to me that the principle defenses must fail for the reason that they are based on a theory of difference between the two patents that apparently would not be accepted by the Supreme Court, according to my interpretation of its two decisions."

As to the *Miami* decision the District Court said (pp. 621 and 622):

> "But, however that may be, these and the other more technical defenses were doubtless considered by the Circuit Court of Appeals in the Third Circuit in the suit of *Minerals Separation, Ltd.* v. *Miami Copper Company*, 244 Fed. 752, involving the validity of this same patent and, while the parties were not the same, I am practically required to follow that decision, based upon substantially the same facts, unless manifest error clearly appears.
>
> * * *
>
> "I think no one who studies the evidence, the diametrically opposed theories of the experts and the elaborate arguments in this case, can say conscientiously that it 'clearly appears that there was manifest error' in the decision of the Circuit Court of Appeals in the Third Circuit. The most that can be said seems to me to be that possibly other minds might take a different view

> of the fundamental difference between the two patents, in which case, unless the decisions of the Supreme Court are construed to impliedly prevent arguments of defendant's counsel based on anticipation and non-patentability would be very persuasive. However, that possibility is far from a situation justifying me in departing from the previous decision and consequently, for me, 'it would be unseemly not to follow a decision which is entitled to the greatest respect * * * determining the title to the same property.'
>
> "It follows that the patent is held valid."

Nevertheless the Circuit Court of Appeals for the First Circuit in the instant case has come to the opposite conclusion, namely, that the agent in solution of the process of patent No. 962,678 has preferential affinity for the mineral particles over gangue and coats them and not the gangue, like the agent of patent No. 835,120, and thereby the Circuit Court of Appeals for the First Circuit has broken down and overridden the definition of "oils of the patent" of patent No. 835,120 given by this Court as above set out (which definition had been followed by the Circuit Court of Appeals for the Third Circuit in the *Miami* case and by the District Court in the instant case) *by including within its terms any and every mineral-frothing agent without discrimination.* And in so doing it has disregarded also the conclusive evidence in the record to the contrary.

That evidence in part took the form of *demonstrations* which were witnessed by the District Court and then described in the record but which the Circuit Court of Appeals for the First Circuit declined to witness.

1. At the trial a demonstration (called the first experiment) was made of the process of patent No. 835,120 *with oleic acid as the agent* (the one and only substance specifically given as an example in that patent), and it was admitted that if this were followed by a careful washing of the resulting froth concentrate with warm water and then by a repetition of the process with a pulp consisting of that so washed concentrate and fresh water, but without the addition of any oleic acid, *a full mineral froth would rise as at first.* (R., Vol. I, pp. 395-397;

pp. 447, 448, Qs198-200; p. 451, Q215.) *This located the active principle in the coating on the mineral particles.*

It was also proved that during the operation of the process of patent No. 835,120 the oil was practically completely removed from the pulp liquor by the froth and that that pulp liquor was thereafter of no further use in the process without the addition of further oleic acid (Higgins, R., Vol. I, p. 451, Q215; pp. 591, 592, Qs796-800). That is to say, it was proved that with this once used pulp liquor and fresh ore and agitation, *no mineral froth whatever was formed or rose.* Everything sank together to the bottom. *This negatived the location of any active principle in the water of the pulp.*

2. Also at the trial a parallel demonstration (called the second experiment) was made of the process of the patent in suit, No. 962,678, *with phenol as the agent* (one of the substances specifically mentioned as an example in that patent) and it was admitted that if this were followed by a careful washing of the resulting froth concentrate with warm water and then by a repetition of the process with a pulp consisting of that so washed concentrate and fresh water but without the addition of any more phenol, *no mineral-froth whatever would rise or be formed.* Everything would sink together to the bottom. (R., Vol. I, pp. 398-401; pp. 448, 449, including Q204.) *This negatived the location of any active principle in a coating on the mineral particles.*

A further experiment was described by plaintiff's expert Higgins (R., Vol. I, p. 449, Q210 and p. 450, Q213). In it the process of the patent in suit was again used with phenol as agent. The water of the pulp was filtered from both the resulting froth concentrate and the resulting tailings and was used as pulp water to treat another batch of ore but without the addition of any more phenol. *A full mineral froth rose as at first. This located the active principle in the water of the pulp.* Higgins repeated the experiment with defendant's ore and defendant's agent (alpha-naphthylamine) with the same result.

The facts so demonstrated and proved are not disputed.

They prove to the point of demonstration the fundamental difference between the two processes that in one (patent No.

835,120) the active frothing principle is located in a coating on the mineral particles and in the other (patent No. 962,678) it is located in the water of the pulp.

Speaking of the first and second experiments, Mr. Higgins said (R., Vol. I, p. 448):

> "Q. 204. What do these experiments demonstrate to you or show you?
>
> "A. They show me that in the first experiment, the mineral-frothing agent coats the metalliferous particles and that in the second experiment the mineral-frothing agent does not coat the mineral particles."

What this Court speaks of as the preferential affinity of the agent of patent No. 835,120 for the mineral particles over the gangue is the power of the agent to preferentially coat those mineral particles. Whatever has that power of preferential coating is the agent of patent No. 835,120. Whatever has not that power of preferential coating is not the agent of patent No. 835,120. This is the conception disclosed by the patent No. 835,120 and the definition of that conception given by this Court.

The facts set out above demonstrate that the agent employed in the process of patent No. 962,678 does not come within this definition and conception. It does not coat the mineral particles and so it cannot have that preferential affinity for them that the patent No. 835,120 requires and that this Court emphasized.

The fallacy of the conclusion of the Circuit Court of Appeals in the instant case, as to anticipation by patent No. 835,120, is that it ignores the test by which the user of the process of patent No. 835,120, skilled in the art, would select any agent to be used in place of oleic acid. The use of oleic acid in the minute quantity prescribed is of course clearly and certainly disclosed. No other agent is specifically disclosed by name, but a test is given for selection of other agents and that test determines the extent of the disclosure beyond oleic acid—determines what the public were taught to do by that patent.

What is that test?

It is written all over the patent* and is woven all through the *Hyde* and the *Butte & Superior* decisions of this Court as stated.

That test is whether the agent in the small quantity prescribed will, as oleic acid does, preferentially coat the mineral particles rather than the gangue, "unite mechanically with" the mineral particles as this Court puts it in the *Hyde* case. If it will, it is an equivalent of oleic acid in the process and its use in place of oleic acid will develop the process and be within the broad disclosure of the patent. If it will not, precisely the contrary is the fact.

An agent like phenol known to be wholly soluble in the small quantity prescribed in patent No. 835,120 would under that test be excluded because known by reason of its solubility to be incapable of coating or mechanically uniting with the mineral particles, either preferentially or otherwise, and so incapable of developing the process of that patent. It would be known that it would be wholly incapable of producing the necessary coating of that process.

If the curious minded had purposely disregarded the test clearly laid down in the patent No. 835,120, or the unintelligent had accidentally disregarded it, and employed a soluble agent like phenol in the minute quantity prescribed in patent No. 835,120 and achieved a mineral-bearing froth, he would not have been practicing the process or following the directions or the disclosure of patent No. 835,120. He would have made a true discovery. He would have achieved a new process.

What purposeful disregard of the tests and directions of patent No. 835,120 might discover, or what unintelligent disregard of those tests and directions might accidentally and unwittingly develop in use or lead to, in the way of subsequent discovery, cannot be regarded as any part of the disclosure of patent No. 835,120 under the law. A prior patent is a legal disclosure only of what is clearly and unquestionably and in-

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* The test is stated or adverted to at the following places in patent No. 835,120; p. 1, ll. 33; 37; 41, 42; 54, 55; 95, 96; p. 2, ll. 4; 14; 104; 128, 129; p. 3, ll. 28; 46, 47; 57; 67, 68; 78, 79; 81, 82; 88-90; 98-100; 109-111; 120-123; 125, 126; 129, 130; p. 4, ll. 5, 6; 19; 22; 32-34; 41-43.

evitably added to the knowledge of the world by it (See authorities, *infra,* p. 124).

This Court in the *Butte & Superior* case held pine oil (when used in conjunction with fuel oil and kerosene) to be an agent of patent No. 835,120. Pine oil comes within the prescribed test because it embodies or includes constituent parts that are insoluble and that coat the mineral particles in preference to the gangue. The fact here proved that it is a complex mixture of substances embodying or including also constituent parts that are soluble and that when in solution are themselves mineral-frothing agents (Higgins, R., Vol. I, p. 491, XQ461) was immaterial to the question of infringement of patent No. 835,120 in that case. Pine oil was not named in patent No. 835,120 nor was any similar complex substance containing both kinds of frothing agents, nor was pine oil or any similar complex substance used in any froth flotation process until long after the discovery and invention of the process in issue and long after the issue and publication of the patent No. 962,678, which latter date was June 28, 1910.

The undisputed facts are that from the time of the invention of the process of patent No. 835,120 until after the invention of the process of the patent in suit, the only froth flotation operations were those in Australia with oleic acid on lead-zinc ores, and that the Hyde infringement, using oleic acid on a zinc ore, did not begin until 1911, and that the concentration of porphyry ores by froth flotation did not begin until January, 1913, and then mainly with cresol and thereafter mainly with cheap complex substances containing soluble phenol and cresol as well as insoluble constituents.

The difference between the processes of the two patents is simply expressed in their respective claims.

Claims 1 and 12 of patent No. 835,120 are (R., Vol. II, pp. 1006-7):

> "1. The herein-described proces of concentrating ores which consists in mixing the powdered ore with water, adding a small proportion of *an oily liquid having a preferential affinity for metalliferous matter,* (amounting to a fraction of one per cent. on the ore), agitating the

mixture until the *oil-coated mineral matter* forms into a froth, and separating the froth from the remainder by flotation."

"12. The process of concentrating powdered ore which consists in separating the minerals from gangue *by coating the minerals with oil* in water containing a fraction of one per cent. of oil on the ore, agitating the mixture to cause the *oil-coated mineral* to form a froth, and separating the froth from the remainder of the mixture."

Claim 1 of patent No. 962,678 is (R., Vol. II, p. 665):

"1. The hereindescribed process of concentrating ores which consists in mixing the powdered ore with water containing *in solution* a small quantity of a mineral-frothing agent, agitating the mixture to form a froth and separating the froth."

The Circuit Court of Appeals for the First Circuit sought to bridge the chasm between these two processes by resorting to discredited theory and disproved speculation and this in an art in which they were essentially inexperienced and uninformed.

The Circuit Court of Appeals for the First Circuit reached the conclusion that the mineral-frothing agents in solution of patent No. 962,678 really come out of solution at the surfaces of the mineral particles and preferentially coat those mineral particles (although nothing is said about any such action in patent No. 962,678) and are therefore oils or oily substances of patent No. 835,120 under the definition given by this Court —this conclusion being based in part on an assumed application of a so-called "adsorption" theory advanced by defendant's experts.

The Circuit Court of Appeals for the First Circuit reached the further conclusion that the oils or oily substances of patent No. 835,120 (and specifically the oleic acid named in that patent) were really soluble in the water of the pulp to such an extent that their mineral-frothing action in the process was dependent upon that solubility (although nothing is said about any such action in patent No. 835,120).

Thus the Circuit Court of Appeals for the First Circuit, with many other confusing errors and misunderstandings of technical terms and of documents, reached the ultimate conclusion that the process of patent No. 962,678 was none other than the process of patent No. 835,120, carried out with a class of agents well within the four corners of the disclosure of patent No. 835,120.

But the application of the adsorption theory is wholly discredited in the evidence, and it is there shown that the agent in solution of patent No. 962,678 does not coat the mineral particles. We treat this error of the Circuit Court of Appeals for the First Circuit more fully later (*Infra*, pp. 52, 55, 57, 64).

Moreover the assumed solubility of the typical agent, oleic acid, of patent No. 835,120, and the explanation of its mineral-frothing power on the basis of that solubility, is pure speculation and speculation that is disproved in the evidence and shown to be a matter *de minimis*, a negligible matter. The defendant's experts who assert such solubility of oleic acid admit that it is of the same order of magnitude as the solubility of window glass in rain water and one of them (Taggart) further admits (R., Vol. I, p. 211, Q38):

> "glass certainly would not be considered soluble for the purposes of flotation."

We enlarge upon this error later (*Infra*, p. 70).

The Circuit Court of Appeals for the First Circuit urged in support of its conclusion of anticipation that the words "insoluble" and "undissolved" do not occur in patent No. 835,120 as characterizing the mineral-frothing agent of that patent, but the reasoning of the Circuit Court of Appeals for the Third Circuit is more sound and persuasive when it says (244 Fed. at p. 773) as heretofore quoted:

> "The difference between the two patents may be shortly stated to be this: The first process rests upon the use in very small quantity of an oily substance *that does not dissolve in water*, coupled with agitation of the pulp, and this succeeds in producing a special froth that

> is remarkably effective in recovering the minute particles of ore. The second process does not employ *oil, or an undissolvable substance;* on the contrary the 'mineral-frothing agent' must be in solution, *and ex vi termini must therefore be dissolvable.*"

The Circuit Court of Appeals for the First Circuit urges, in support of its conclusion, that two of the agents specified in patent No. 962,678 are known as "oils" in the market, but this does not make them oils of patent No. 835,120 any more than the commercial name "oil of vitriol" for sulphuric acid, makes it an oil of that patent.

The Circuit Court of Appeals for the First Circuit misconstrues certain references in patent No. 835,120 to prior art Cattermole and other patents, as importing into the disclosure of that patent No. 835,120, agents specified in those prior art patents for other purposes and other processes but not specified in patent No. 835,120. We treat of this later (*Infra,* pp. 83-93).

The Circuit Court of Appeals for the First Circuit misconstrues a New Zealand patent by reason of the mere juxtaposition in it (for economy's sake) of the descriptions and claims of the inventions of three United States patents, patent No. 835,120 and two prior Cattermole patents. We treat of this later (*Infra,* pp. 93-99).

The Circuit Court of Appeals in the instant case failed utterly to comprehend that the process of patent No. 835,120, as interpreted and construed by this Court, was a process that depended upon, and acted solely by reason of, the preferential coating of the metalliferous mineral particles with an undissolved oily substance, whereas the process of the patent here in suit, No. 962,678, depends upon, and proceeds by reason of, the modifying of the water of the pulp by a substance which is completely dissolved in that water and does not and cannot "unite mechanically with" the metalliferous mineral particles.

We will, in the detailed discussion of these various matters, consider first the process of the alleged anticipating patent No. 835,120, then the process of the patent in suit No. 962,678, then compare the two, and then point out the errors of the Circuit Court of Appeals for the First Circuit.

SULMAN, PICARD & BALLOT PATENT NO. 835,120

The art prior to this patent, No. 835,120, was well summed up by this Court in *Minerals Separation, Limited* v. *Hyde*, 242 U. S. 261, and the evidence in the case at bar makes substantially no change in the prior art as thus summarized. This Court said (242 U. S. 264, 265):

> "It is clear that in the prior art, as it is developed in this record, it was well known that oil and oily substances had a selective affinity or attraction for, and would unite mechanically with, the minute particles of metal and metallic compounds found in crushed or powdered ores, but would not so unite with the quartz, or rocky non-metallic material, called 'gangue'. Haynes British patent (1860), and United States patents, Everson (1886), Robson (1897) and Elmore (1901). It was also well known that this selective property of oils and oily substances was increased when applied to some ores by the addition of a small amount of acid to the ore and water used in process of concentration. United States patents, Everson (1886), Elmore (1901), and Cattermole (1904).
>
> Prior to the date of the patent in suit [No. 835,120] a number of patents had been granted in this and other countries for processes aiming to make practical use of this property of oil and of oil mixed with acid in the treatment of ores, all of which, speaking broadly, consisted in mixing finely crushed or powdered ore with water and oil, sometimes with acid added, and then in variously treating the mass—'the pulp'—thus formed so as to separate the oil, when it became impregnated or loaded with the metal and metal-bearing particles, from the valueless gangue. From the resulting concentrate the metals were recovered in various ways.
>
> The processes, of this general character, described in the prior patents, may be roughly divided into two classes. The process in the patents of the first class is called in the record the 'Surface Flotation Process,' and it depends for its usefulness on the oil used being sufficient to collect and hold in mechanical suspension the small particles of metal and metalliferous compounds, and by its buoyancy to carry them to the surface of the mixture of

ore, water and oil, thus making it possible, by methods familiar to persons skilled in the art, to float off the concentrate thus obtained into any desired receptacle. The waste material, or gangue, not being affected by the oil, and being heavier than water sinks to the bottom of the containing vessel and may be disposed of as desired.

The process of the other class, called in the record the 'Metal Sinking Process,' reverses the action of the Surface Flotation Process and is illustrated by the Cattermole U. S. Patent, No. 777,273, in which oil is used to the extent of 4% to 6% to 10% of the weight of the metalliferous mineral matter, depending on the character of the ore, for the purpose of agglomerating the oil-coated concentrate into granules heavier than water, so that they will sink to the bottom of the containing vessel, permitting the gangue to be carried away by an upward flowing stream of water."

Patent No. 835,120, issued November 6, 1906, is Defendant's Exhibit 54 (R., Vol. II, pp. 1002-1007).

The invention disclosed utilizes the selective action of oily substances in water for metalliferous mineral particles in preference to gangue in such manner that the metalliferous mineral particles in the ore pulp will be coated with the oily substances and the oil-coated metalliferous particles will become attached to air bubbles and will rise to the surface in the form of a froth which will float upon the surface of the pulp and may be separated from the pulp in any suitable manner, as by overflowing or skimming. It utilizes the preferential affinity of oil for metalliferous matter over gangue in an ore pulp—the action of oil globules diffused or disseminated through an ore pulp in attaching themselves to the metalliferous particles with which they are brought into contact and not attaching themselves to the gangue particles with which they are also brought in contact. Conversely it utilizes the preferential affinity of water for gangue over metalliferous matter and especially over oil-coated metalliferous matter—the action of the water in wetting the gangue particles and persistently covering them and in repelling the oil so that it escapes from the water to the surface of the metalliferous particles and coats the metalliferous particles. Further, in a pulp of oil-

coated metalliferous particles and wetted gangue particles, it utilizes, under agitation, the preferential affinity of air bubbles for these *oil-coated metalliferous particles* over the wetted gangue particles so as to form a *froth of oil-coated metalliferous particles.*

The opening statement of the specification as to the nature and object of the invention broadly defines the substances which are to be used and yet carefully limits them to (Spec., p. 1, lines 13-15):

> "substances which have a preferential affinity for metalliferous matter over gangue."

This preferential affinity must of course be exercised in an ore pulp. It can only be exercised by substances which remain undissolved in the water of the pulp and it results in the coating of the metalliferous matter in preference to the gangue in an ore pulp, as the specification repeatedly states.

The specification first refers to the Cattermole granulation patent No. 777,273 (Spec., p. 1, lines 16-17) for a metal-sinking process, wherein an amount of oil which, as testified to by Mr. Higgins (R., Vol. I, p. 503, XQ563) is about 1.8% on the ore (Spec., p. 1, lines 20-22) or 36 pounds to the short ton of ore,

> "is agitated with an ore pulp, so as to form granules which can be separated from the gangue."

It then refers to the Cattermole, Sulman and Picard patent No. 777,274, wherein, it says (Spec., p. 1, lines 25-27)

> "a similar method of separation is employed, oleic acid being produced *in situ* in the ore pulp."

This method of separation, common to these two Cattermole patents, is separation by sinking the oiled metalliferous mineral particles in granules and flowing off the gangue particles upward in suspension in an up-current of water. Both patents disclose only *metal-sinking processes.*

It will be noted that the reference to these Cattermole patents is not for the purpose of defining the frothing agents to

be used. That has already been defined and limited to "substances which have a preferential affinity for metalliferous matter over gangue" by the statement just preceding.

The reference to the first Cattermole patent is a proper reference to the process which formed the basis for the discovery to be announced in the next paragraph. Its especial reference is to the *amount* of oil used in that process to produce the phenomena of granulation and metal sinking. It was so treated by this Court in the *Hyde* case and in the *Butte & Superior* case.

The other reference is to the soap and granulation patent No. 777,274, and is specifically *confined to the disclosure of oleic acid therein,* and forms the basis for a further statement in the specification of patent No. 835,120 (also specifically confined to the use of oleic acid), viz.: Spec., p. 2, lines 9-13, wherein the method disclosed in that soap and granulation patent of producing *oleic acid in situ* in a pulp (introducing into the pulp soluble oleic soap, disseminating it as soap throughout the pulp, and then decomposing the oleic soap *in situ* by sulphuric acid and thereby forming insoluble oleic acid which will, by reason of its insolubility, be immediately precipitated out of the solution and then will, by reason of its preferential affinity for the metalliferous mineral, coat the metalliferous mineral) is referred to as one method of bringing about the dissemination of oleic acid in the pulp for the purposes of the process of patent No. 835,120.

There is also a reference to the method of recovering the oleic acid from the metalliferous mineral particles after it has coated them and they have been separated from the gangue particles to form the concentrate the separation of which concludes the operation of concentration, to wit, the treatment of the oil-covered concentrate with alkali so as to form oleic soap which by reason of its solubility can be readily washed off the particles for re-use. This recovery of the oleic acid for re-use was worth while in the Cattermole process, which used a minimum of 36 pounds of oleic acid to the ton of ore—and the inventors had been thinking in terms of that process—but it turned out to be not worth while in the froth-flotation process patent No. 835,-

120, where only 2 pounds of oleic acid were used to the ton of ore.

These references to the procedure of the soap and granulation patent in the specification of patent No. 835,120 are as follows (R., Vol. II, p. 1005, Spec., p. 2, lines 3-13):

> "After subsidence the oil-coated metalliferous matter removed as froth is separated from any liquid which may have accompanied it and treated with a dilute solution of caustic alkali, which removes the oleic acid in the form of a solution of soap.
>
> "If desired, the oleic acid used in the first instance may be produced *in situ* in the pulp by decomposing a dilute soap solution with mineral acid, as described in the previous patent, No. 777,274, cited above."

It is to be particularly noted that these references in patent No. 835,120 to the process disclosed in patent No. 777,274 are limited to oleic acid. They merely show that according to what is disclosed in patent No. 777,274 the minute amount of oleic acid which is used in the process of patent No. 835,120 may be formed *in situ* in the pulp by introducing therein soluble oleic soap from which it may be formed by chemical decomposition so as to be precipitated as an undissolved substance in the pulp to preferentially coat the metalliferous mineral particles, and may be recovered from the coated metalliferous mineral particles, after the operation of concentration has been completed (if worth while) by treating them with caustic alkali so as to again form oleic soap which may be washed off the metalliferous mineral particles and used over again in the process.

As to the reference in patent No. 835,120 to Cattermole patent No. 777,273, this, as above noted, was merely a proper reference to the process which formed the basis of the discovery of the process of patent No. 835,120 and to the *quantities* of oil used therein, and was not in any respect a reference to that patent for a disclosure of substances to be used, since it was preceded by a definition of the substances to be used as those having "a preferential affinity for metalliferous matter over gangue" (R., Vol. II, p. 1004; Spec., p. 1, lines 13-15) and was

necessarily limited to substances which in the operation of the process would exercise that preferential affinity.

The errors of the Circuit Court of Appeals for the First Circuit in the inferences drawn from the references in patent No. 835,120 to these two patents, Nos. 777,273 and 777,274, are pointed out at pp. 83, 86, 91-93, 100-106, *infra.*

Any intelligent consideration of patent No. 835,120 and its references to the two prior metal-sinking process patents, above noted, makes it quite clear that the only disclosure in patent No. 835,120 is of a process of froth flotation wherein an undissolved substance is employed which functions by reason of its insolubility, and that the operation of the process is dependent upon the coating by an undissolved substance of the metalliferous mineral particles and what results from that coating.

The discovery of the process of patent No. 835,120 is announced as follows (Spec., p. 1, lines 28-35):

> "We have found that if the proportion of oily substance be considerably reduced—say to a fraction of one per cent. on the ore—granulation ceases to take place, and after vigorous agitation there is a tendency for a part of *the oil-coated metalliferous matter* to rise to the surface of the pulp in the form of a froth or scum."

This is an announcement of the discovery that a considerable reduction in the amount of oil in a procedure wherein the pulp is agitated as in the Cattermole granulation process will change that procedure from one of granulation and metal sinking of oil-coated metalliferous matter to one of froth flotation of oil-coated metalliferous matter.

Then follows a number of statements as to preferential features in the process, for example (Spec., p. 1, lines 36-38):

> "Thus the water in which the *oiling* is effected is preferably slightly acidified"

and further (Spec., p. 1, lines 41-44)

> "the effect of this acidity being to *prevent gangue from being coated with oily substance,* or, in other words, to render the *selective action of the oil* more marked."

Another factor, heating, is referred to as follows (Spec., p. 1, lines 51-56):

> "Again, we have discovered that the tendency for the oily substance to disseminate through the pulp and the rapidity with which the *metalliferous matter becomes coated* is increased if the pulp is warmed."

Then there is a statement of the advantage to the process of fine pulverization of the ore (formerly highly objectionable), and then follows the direction as to testing with different ores and different oily substances which was commented upon by this Court (*Infra,* p. 35).

It is to be noted here that this suggestion to test different oily substances with different ores follows all that has been quoted above as to preferential affinity and selective action and the production of oil-coated metalliferous matter, so that it cannot be otherwise interpreted than as a direction to use such oily substances as act by reason of their insolubility in water—such as can be disseminated in an undissolved condition through an ore pulp so as to coat the metalliferous matter, or, in other words, exercise preferential affinity for metalliferous matter over gangue when disseminated through an ore pulp. A metallurgist is taught by this specification throughout that he must coat his metalliferous mineral if he is to carry on the process disclosed, that the oily substance functions in the process solely by coating the metalliferous mineral, and therefore is taught that any substance which completely dissolves when used in such proportions as this patent indicates should be rejected as incapable of carrying on the process here disclosed. And not only is this apparent from the reading of the specification, but it is what in fact happened. That is what the metallurgists of the art were taught and that is what they did prior to the invention here in issue, and the fact is that oleic acid was the only oily substance that was actually used in practice (Higgins, R., Vol. I, p. 512, XQs593, 594) from the installation of the process on a large scale and with highly successful results in Australia, commencing in the year 1905 and continuing down to the date of the invention of the process here

in suit. The use of mineral-froth flotation was limited to these Australian zinc-lead ores and was not extended to other ores until after the invention in issue was made. Defendant has been unable to adduce any evidence that anyone, skillful or ignorant, in testing the application of the process of patent No. 835,120 or in using that process, prior to the second astonishing discovery which resulted in the invention of the patent here in suit, ever used a mineral-frothing agent in solution. There is not the faintest glimmer of a suggestion in this patent No. 835,120 of the use of a mineral-frothing agent in solution or of any possibility of carrying on the froth concentration of ores except by the employment of substances which remain undissolved in the ore pulp and function to preferentially coat the metalliferous mineral particles by reason of the fact that they exist in undissolved condition in the ore pulp.

Then follows an example of the use of oleic acid with a zinc-lead ore, to wit, Broken Hill ore, with sulphuric acid, and the warming of the mixture, and with a brisk agitation (Spec., p. 1, lines 86-88)

> "until the oleic acid has been brought into efficient contact with all the mineral particles in the pulp."

and it is said that when the agitation is stopped the mineral rises in the form of a froth (Spec., p. 1, lines 91-96)

> "which has derived its power of flotation mainly from the inclusion of air-bubbles introduced into the mass by the agitation, such bubbles or air-films adhering only to the mineral particles which are *coated with oleic acid.*"

Then follow directions for the removal of the froth.

The specification also describes (Spec., p. 2, lines 103, 104)

> "an alternative method for the recovery of any sunk *oiled metalliferous matter*"

which is the superaeration or plus-pressure method, and in that description the mineral to which air bubbles are attached to raise them is called "*the oiled mineral*" (Spec., p. 3, line 28).

This superaeration or plus-pressure method or process was divided out from the application for patent No. 835,120 as a

separate invention, and became patent No. 835,479 (Defendant's Exhibit 60, R., Vol. II, pp. 1045-1047).

Claims. The first three claims of patent No. 835,120 are for "an oily liquid having a preferential affinity for metalliferous matter" and point out a procedure wherein the ore pulp is agitated *"until the oil-coated mineral matter forms into a froth."*

The fourth claim is for "an oily substance having a preferential affinity for metalliferous matter" and points out a procedure wherein the ore pulp is agitated *"until the oil-coated mineral matter forms into a froth"* and further specifies "removing the oily coating from the mineral."

Claims 5, 6 and 7 are oleic acid claims and point out a procedure wherein the pulp is agitated "until the oleic acid has been brought *into efficient contact* with the mineral and has formed a froth therewith."

Claim 8 is for the use of "oleic-soap solution" and repeats the language above quoted from claims 5, 6 and 7, and further includes "filtering off the froth and removing the oleic acid therefrom."

Claims 9, 10 and 11 are oil claims and prescribe *"coating the mineral with oil in water."* This language is substantially repeated in claim 12.

Claim 13 is an oleic acid claim and highly specific, and repeats the language which has been quoted from claims 5, 6 and 7 as to bringing the oleic acid into efficient contact with the mineral and the language quoted from claim 8 "filtering off the froth and removing the oleic acid therefrom."

As will be seen, this was a patent for a specific phenomenon, and it was so interpreted by this Court, although it turned out that that specific phenomenon was a matter of very great importance in the art. That specific phenomenon most broadly stated was the coating of mineral particles with an oily substance when the mineral particles were suspended in water in preference to the gangue particles there present and also suspended in the water, the oil being used in such minute amounts as does not cause the oiled mineral particles to adhere to-

gether and form granules but causes the oiled mineral particles to adhere to air bubbles and form a froth.

This Court, in its decision in the *Hyde* case (242 U. S. 261, 265) said as to patent No. 835,120:

> "The process of the patent in suit, as described and practiced, consists in the use of an amount of oil which is 'critical,' and minute as compared with the amount used in prior processes, 'amounting to a fraction of one per cent. on the ore,' and in so impregnating with air the mass of ore and water used, by agitation—'by beating the air into the mass'—as to cause to rise to the surface of the mass, or pulp, a froth, peculiarly coherent and persistent in character, which is composed of air bubbles with only a trace of oil in them, which carry in mechanical suspension a very high percentage of the metal and metalliferous particles of ore which were contained in the mass of crushed ore subjected to treatment. This froth can be removed and the metal recovered by processes with which the patent is not concerned."

and in the *Butte & Superior* case (250 U. S. 336, 345) this Court further said:

> "We held in the former case that the patentees came late into the field of ore concentration investigation, and that their discovery rests upon a prior art so fully developed that it was 'clear from the record that approach was being made slowly, but more and more nearly, to the result which was reached by the patentees of the process in suit in March, 1905,' and that their final step was not a long one.
>
> "Such a patent, in such a field of investigation, must be construed strictly, but candidly and fairly, to give to the patentees the full benefit, but not more, of *the disclosure of their discovery which is to become a part of the public stock of knowledge upon the expiration of the patent period,* and which was the consideration for the grant to them of a patent monopoly.
>
> "With the state of the prior art in mind, we come to consider the nature and extent *of the disclosures* of the patent in suit, but only with respect to the kinds and quantities of oil which may be used in the process."

And in summing up as to the disclosure of patent No. 835,120 this Court further said (p. 349):

> *"the only disclosure* as to the kind and amount of oil which the patentees made to the public as necessary to the practicing of their process is that it must be an oil or oily substance, or oily liquid having a *'preferential affinity for metalliferous matter,'* and that it shall be limited in amount 'to a fraction of one per cent. on the ore'."

SULMAN, GREENWAY & HIGGINS PATENT NO. 962,678, BEING THE PATENT IN SUIT.

The patent in suit No. 962,678, issued June 28, 1910, to Henry Livingstone Sulman, Henry Howard Greenway and Arthur Howard Higgins, is printed at R., Vol. II, pages 663 to 666. It contains, as we believe and submit, the first disclosure of an ore concentration process which proceeds by the operation of a mineral-frothing agent in solution—the first process wherein a soluble mineral-frothing agent dissolved in the water of an ore pulp, and so modifying that water, was utilized to concentrate the ore by mineral-froth flotation.

The patent in suit issued some four years later than the Sulman, Picard and Ballot patent No. 835,120, so fully interpreted and construed by this Court in its two decisions above referred to.

The process of the patent in suit is a departure from, and a discarding of, all the learning of the art as to the repulsion of oil and water and the preference of oil for metalliferous mineral over gangue in the presence of water. Oils, as such, are abandoned. Instead of being built up on the insolubility of oil and similar substances in water, as was practically the whole prior art of ore concentration, including the process of patent No. 835,120, the process of the patent in suit is built up on, and limited to, the solubility of mineral-frothing agents in water. It makes known the astonishing new principle that air bubbles in agitated water that has been *modified by dissolving* certain substances in it can be relied upon (1) to select the metalliferous mineral from the gangue without oil-coating of that mineral, (2) to attach themselves firmly to the so selected metalliferous mineral particles, (3) to float the metalliferous mineral particles to and through the pulp surface and

(4) to form floating upon the surface of the pulp a froth carrying very nearly the whole of the metalliferous content of the ore ready to be overflowed as a product which will constitute a substantial and valuable concentration of the ore.

Sulman, Greenway and Higgins *discovered a new property or force in matter,* namely: the mineral-selecting and mineral-lifting power of air bubbles produced in water modified by the presence of a mineral-frothing agent in solution under the agitation conditions of froth flotation.

It was not a mere discovery of a series of individual frothing agents which in solution and under proper conditions of agitation would develop that mineral-selecting and mineral-lifting force, but it was the discovery broadly of the mineral-selecting and mineral-lifting force of air bubbles produced in water having in solution *soluble mineral-frothing agents generally as a class* under the agitation conditions specified. All mineral-frothing agents in solution will effect the result desired.

As to this particular class of frothing agents—mineral-frothing agents in solution—and as to the newly discovered mineral-selecting and mineral-lifting forces involved, Sulman, Greenway and Higgins *were pioneers.*

The discovery ran counter to all experience and all theory.

It flew in the face of all the teachings of the art.

It broke away from all tradition.*

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* All of the flotation processes of the prior commercial art (with possibly one exception, i.e, Potter-Delprat) depended upon the preferential affinity of the frothing agent for the mineral and the consequent coating of the mineral by the agent, for example, the Elmore bulk oil process, the froth flotation process of 835,120, and the Elmore vacuum process. Moreover the flotation processes of the paper art that never got into commerce similarly depended upon the preferential affinity of the agent for the mineral and the consequent coating of the mineral by the agent, for example, Haynes, Everson, Bessel and many others. This preferential affinity of the agent for the mineral particles and the consequent preferential coating of those mineral particles is pointed out and is emphasized by this Court in *Minerals Separation Ltd.* v. *Hyde,* 242 U. S. 261 and *Minerals Separation Ltd.* v. *Butte & Superior,* 250 U. S. 336.

This preferential affinity of the agent for the metal and the coating of the metal by the agent involves and requires an undissolved or immiscible agent, that is, immiscibility of the agent in the water of the pulp under the conditions of the process.

The Bessel Patents and the Elmore vacuum patents and publications were not before this Court in the cases cited but they both specify the greasing or coating of the metal particles achieved by reason of the preferential affinity of the agent for them, and they both specify or assume insolubility of the agent to that end and these things as a *sine qua non* in each case of the processes disclosed.

The invention was the process proceeding in the flotation cell when such a frothing agent was put in solution in the water of the pulp under conditions of agitation to form a froth, whereby the newly discovered mineral-selecting and mineral-lifting forces in such a froth were developed and utilized.

The process was not the mere mill manipulation but it was as stated what went on in the flotation cell when the pulp and the new reagent were agitated together to form the froth.

That process and invention departed from what had been the very pith and point of the process and invention utilizing undissolved agents of patent No. 835,120.

It violated what had been universally accepted as the *sine qua non* of ore concentration by flotation, namely, the preferential affinity of the frothing agent for the mineral and the consequent coating of the mineral by the frothing agent.

The necessary quality or characteristic of producing when in solution a froth having the newly discovered mineral-selecting and mineral-lifting force *is a class quality or characteristic,* for the class is defined in the claims in issue by that quality or characteristic. *Everything within the terms of those claims will perform the functions required.*

But there are frothing agents which are not mineral-frothing agents. These are exceptions to this rule. The patent gives examples of these exceptions.

The patent also prescribes a simple test to enable the user to determine in any given case what is a mineral-frothing agent of the patent and what is not.

This satisfies the law.

The trial Judge in his opinion, after referring to patent No. 835,120 and the interpretation thereof by this Court, says very accurately (R., Vol. I, p. 619):

> "Into this field, with the process of the first patent [No. 835,120] as a part of the prior art, came the patentee of the second patent,—the patent in suit,—with an undoubted improvement; a process not dependent upon the oily coating of the mineral particles but utilizing a hitherto unknown property of mineral-frothing agents in solution to form air bubbles which attract

> and attach themselves to the uncoated and unoiled mineral particles."

and again (p. 620):

> "But the principle of action,—so far as it is known,—involved in the process in suit, is not the preferential affinity of the frothing agent used for the mineral particles or the coating of those particles, or the attachment of air bubbles to coated particles, as in the first patent, because the frothing agent goes into solution without coating either mineral or gangue, and the law of attraction and attachment of air bubbles to oil-coated mineral particles cannot apply. The process in suit, as it is put by counsel for plaintiff in their brief, 'proceeds by reason of the peculiar character of the air bubbles produced in water modified by the presence of the dissolved mineral-frothing agent employed and by reason of the attraction and attachment of such air bubbles for uncoated metalliferous mineral particles'."

The substances which when dissolved in the water of an ore pulp thus modify the water so as to bring about this selection and attachment and mineral-froth formation by air bubbles, are designated in the patent as mineral-frothing agents in solution. This was a new term in the art, a new classification of substances, classifying them by the newly discovered and theretofore unsuspected capability of imparting to air-bubbles in agitated water, by reason of their being dissolved in the water, these mineral-froth forming qualities. This new class of substances includes substances that are not and cannot by any stretch of the imagination be classed as oils, such as the normally solid substances—camphor (Pltff.'s Ex. 26), benzoic acid (Pltff.'s Ex. 24), alpha naphthylamine (X-cake) (Deft.'s Ex. 116); and the normally liquid substances: lactic acid (Pltff.'s Ex. 25), acetic acid (vinegar) (Higgins, R., pp. 530, 531, RDQs709-712) and alcohol (Sulman patent No. 955,012, R., Vol. II, p. 1060); and also the inorganic mineral-frothing agent in solution, common salt or sodium chloride (Higgins, R., Vol. I, p. 471, Q345). This new class of substances also includes the crystalline solid substance phenol (Pltff.'s Ex. 23) familiar in its weak solutions as the antiseptic known as car-

bolic acid, when used in such small quantity that it is wholly dissolved in the water of the ore pulp. The new class includes also the soluble constituents of some complex substances, one of which known as pine oil, contains several different substances, some of which are soluble and others insoluble (Higgins, R., Vol. I, p. 491, XQ461), but the new class excludes all of the substances therein that are insoluble. It excludes certain soluble substances which promote froth formation, such as "some sugars, dextrine, saponin, albumen, ox gall, etc." (Spec. p. 1, lines 48, 49) but which, as stated in the patent, "in solution will not effect the result described" (*ib.*, lines 47, 48), i. e., will not form a useful mineral-bearing froth.

In the process of the patent in suit the mineral-frothing agent goes into solution and does not coat the metalliferous mineral particles. It modifies the water and causes the production in the modified water (for one thing) of a fineness of bubbles and a great increase in the number of bubbles as compared with the insoluble mineral-frothing agents theretofore known and (for another thing) bubbles having a greater ease of attachment to mineral particles. Mr. Higgins testified as follows (R., Vol. I, pp. 473, 474):

> "Q. 356. Now, will you compare the process of air-froth flotation as carried on with insoluble mineral-frothing agents, with the process of air-froth flotation as carried on with soluble mineral-frothing agents?
>
> A. In the use of the air-froth flotation process with an insoluble mineral-frothing agent, the mineral-frothing agent coats the metalliferous particles, whereas, in the use of the air-froth flotation process with the soluble mineral-frothing agent, the mineral-frothing agent does not coat the metalliferous particles, but goes into solution. In the case of the soluble mineral-frothing agent, there is a great increase in the number of bubbles which are formed by the same kind of agitation. They are sensibly smaller than in the use of an insoluble mineral-frothing agent. I think those are the major differences."

And further (p. 476):

> "Q372. Now, in the process of air-froth flotation employing soluble frothing-agents, what, in your opinion, does the soluble frothing-agent do in the process?

A. It forms or assists in the formation of a very large number of minute bubbles which attach themselves to the mineral particles.

The Court: Is that the purpose of that frothing agent to produce more bubbles?

The Witness: Yes, sir, it produces more bubbles of such nature that they have a greater ease of attachment to the mineral particles."

The specification opens with a general statement of the nature and objects of the invention (p. 1, lines 9-14), which needs no comment. This is followed by a very full statement of practices according to the invention (p. 1, lines 15-52), then by an example of one method of carrying the invention into effect (p. 1, lines 53-78), and then by a reference to the drawings, which show one form of apparatus for use in the process (p. 1, lines 79-83), and a particular description of the operation of the process as carried on in this apparatus (p. 1, line 84; p. 2, line 16). This completes the disclosure.

Then follow references to prior patents and processes and statements pointing out the novel features of the invention (p. 2, lines 17-67), and then a disclaimer (p. 2, lines 68-77).

The statement of practices according to the invention is, like other parts of the disclosure, for the information of those skilled in the art, so as to enable them to use the invention. In order that the information afforded may be accurate such a statement should, of course, be founded upon the actual investigations of the inventors and should not go beyond the knowledge which the inventors actually possess at the time of preparing their specification. And we find in this paragraph an excellent summary of investigations covering a wide field, highly informative of the nature of the invention and fully justifying the broad claims which appear, as they should, at the end of the specification. Such a statement does not usurp the functions of the claims, but should be, as it is, helpful in arriving at the true meaning of the claims. For example the term "mineral-frothing agent" qualified by the words "in solution," which appears in the claims, is here defined as one or

more substances which in solution enable metallic sulphides to float under conditions of agitation such that the ore particles suspended in a liquid such as water come in contact with a gas and the metallic sulphide particles float to the surface in the form of a froth which can be separated by well known means. Then follows this statement, naming certain substances, which have been found to be included within this term (Spec. p. 1, lines 30-35):

> "Among the organic substances which in solution we have found suitable for use as mineral-frothing agents with certain ores are amyl acetate and other esters; phenol and its homologues; benzoic, valerianic and lactic acids; acetones and other ketones such as camphor."

This it will be noted is the naming of a number of substances *which have been found suitable,* but these substances are not even said to be all that have been found suitable, and many substances are named by classes, such as esters, phenol homologues and ketones. This statement gives to the skilled metallurgist knowledge of the researches of the inventors. It is plainly well within what the inventors have actually determined by test. The statement is of what the inventors have found to be true.

It is then suggested that results are sometimes improved with the use of two or more of these mineral-frothing agents in admixture, and then comes the statement (p. 1, lines 39-45):

> "The above mentioned mineral-frothing agents are all more or less effective in the presence of an acid such as sulphuric acid and are given as types but are not intended to form an exhaustive list of suitable organic substances which may be used in this manner and for these objects."

Thus we learn that the mentioned substances which have been found to be effective with certain ores, have, *with these certain ores,* been found to be effective in the presence of such an acid as sulphuric acid, but we are further informed that these substances which have been so found to be effective with

an acid are merely given as types and are not intended to form an exhaustive list of substances or even of organic substances which may be used in processes embodying the invention. These disclosures of what the inventors have found to be facts in relation to their invention, of procedures that they have tested and found to be in accordance with their invention, accompanied by the statement that these substances are given as types or examples and not as a full or exhaustive list of what they have defined as mineral-frothing agents, are entirely consistent with the broad claims in issue, and are in compliance with the law as to disclosures in a specification.

Then follows the statement (p. 1, lines 46-52):

> "On the other hand there are many organic compounds which in solution will not effect the result described, such as some sugars, dextrin, saponin, albumen, ox gall, etc., and a simple test is required in the case of varying ores or materials to determine which organic compound is most suitable."

The statement here given as to soluble organic substances which are not mineral-frothing agents has been heretofore commented upon.

As to the requirement of tests with varying ores and varying mineral-frothing agents, the inventors here state the necessary and usual procedure of metallurgists, and their disclosure as a whole is as definite and as precise as under the circumstances of the case it was reasonably possible for them to make it. A similar disclosure in patent No. 835,120, although it named "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" (Spec. 835,120, p. 1, lines 12-15; Vol. II, p. 1004) gave but a single example, oleic acid, and then said (*ib.* Lines 61-79):

> "The proportion of mineral which floats in the form of froth varies considerably with different ores and with *different oily substances,* and before utilizing the facts above mentioned in the concentration of any particular ore a simple preliminary test is necessary to determine

> *which oily substance* yields the proportion of froth or scum desired."

As to this disclosure this Court said in *Minerals Separation, Ltd.* v. *Hyde,* 242 U. S. 261, at 270, 271:

> "Equally untenable is the claim that the patent is invalid for the reason that the evidence shows that when different ores are treated preliminary tests must be made to determine the amount of oil and the extent of agitation necessary in order to obtain the best results. Such variation of treatment must be within the scope of the claims, and the certainty which the law requires in patents is not greater than is reasonable, having regard to their subject-matter. The composition of ores varies infinitely, each one presenting its special problem, and it is obviously impossible to specify in a patent the precise treatment which would be most successful and economical in each case. The process is one for dealing with a large class of substances and the range of treatment within the terms of the claims, while leaving something to the skill of persons applying the invention, is clearly sufficiently definite to guide those skilled in the art to its successful application, as the evidence abundantly shows. This satisfies the law. *Mowry* v. *Whitney,* 14 Wall, 620; *Ives* v. *Hamilton,* 92 U. S. 426, and *Carnegie Steel Co.* v. *Cambria Iron Co.,* 185 U. S. 403, 436, 437."

As stated by this Court the essential thing as to variations of treatment is that they *"must be within the scope of the claims,"* and this being so, "the range of treatment *within the terms of the claims* * * * is clearly sufficiently definite to guide those skilled in the art to its successful application" and "satisfies the law."

The decision of this Court upon a similar set of circumstances is a complete answer to all of defendant's attacks upon the certainty of the disclosure of the patent in suit, upon the omission from that disclosure of the specific organic soluble mineral-frothing agent which the defendant uses, and upon the fact that the patent does not affirmatively say that certain soluble mineral-frothing agents with certain ores may be employed in neutral or alkaline pulps in procedures embodying

the invention claimed. Any procedure "within the scope of the claims" or "within the terms of the claims" is within the scope of the patent and is an infringement.

The function of the disclosure of a specification is to assist in the understanding of the claims, and when therefore we find, as in the claims of the patent in suit, the expression "agitating the mixture to form a froth," we may look to the specification to assist us in understanding just what is meant by this simple language. It may be noted, however, that the language of the claims is so simple, direct and complete that we are really only concerned with the consistency of the claims with the disclosure.

The specification says (p. 1, lines 22-29)

> "the mixture is thoroughly agitated; a gas is liberated in, generated in, or effectively introduced into the mixture and the ore particles come *in contact with the gas* and the result is that *metallic sulphide particles float to the surface in the form of a froth or scum.*"

Obviously agitation to form a froth requires the presence in the ore pulp of such bubbles of air or other gas as will form a froth, and agitation to form a froth in "a process of concentrating ores" is such agitation as will form that kind of a froth which on separation will effect a concentration of the ore. The claim does not prescribe the manner in which these air or other gas bubbles shall be introduced into the ore pulp, and so there is no limitation in the scope of the claims as to the manner of the introduction of these bubbles, but the specification by way of disclosure says that a gas may be "liberated in" the pulp, (as by reduction of pressure which will cause air to escape from solution and form bubbles in the pulp), or may be "generated in" the pulp (as by chemical action generating a gas in the pulp), or may be "effectively introduced into" the pulp (as by blowing air into the pulp through a porous medium as defendant does). The skilled metallurgist to whom the specification is addressed is thus given a wide range of instruction as to the method of bringing about that necessary intro-

duction of bubbles of air or other gas into the ore pulp which will develop the selective action of the air or gas bubbles for the sulphide particles in the pulp and the formation of a mineral-bearing ore-concentrating froth. It should be noted that in the practical work of the art, air is the only gas used. It costs nothing except the cost of the power required to draw it into the pulp or to compress it and blow it into the pulp.

The example of one method of carrying the invention into effect is, of course, merely an example, but it is characterized by such minute and specific description as is necessary to assure that the skilled metallurgist may precisely follow it in order to exactly repeat it. It is suggested that "the tailings can be retreated by the same process" (Spec. p. 1, lines 73, 74), as defendant does, and that this may be done "with or without the addition of fresh quantities of the organic materials referred to" (Spec. p. 1, lines 74-76) (and defendant retreats without the addition of fresh quantities of soluble mineral-frothing agent) and that "The action may in some instances be improved by heating the mixture" (Spec., p. 1, lines 76-78). The latter suggestion justifies claim 8, which includes heating the mixture as an essential element and which is the only claim so limited.

Since the apparatus shown is stated to form no part of the invention (Spec., p. 1, lines 82, 83) and no question is raised as to the accuracy of the description of the operation of this apparatus and the carrying on of the process therein, there is no occasion for commenting upon this quite full description.

Claims. The invention of the patent in suit is well summed up in the claims. The claims in issue, stated analytically, without alteration in words or punctuation, are as follows:

1. The herein described process of concentrating ores which consists in

(a) mixing the powdered ore with water containing in solution a small quantity of a mineral-frothing agent,

(b) agitating the mixture to form a froth and

(c) separating the froth.

2. The herein described process of concentrating ores which consists in

(a) mixing the powdered ore with water containing in solution a small quantity of an organic mineral-frothing agent,

(b) agitating the mixture to form a froth and

(c) separating the froth.

The only difference between claims 1 and 2 is that in place of "a mineral-frothing agent" as specified in claim 1, claim 2 specifies "an organic mineral-frothing agent." Thus claim 2 does not cover a process employing an inorganic mineral-frothing agent in solution, such as common salt or sodium chloride, whereas claim 1 does.

Common salt (sodium chloride) is a soluble mineral-frothing agent with copper ores (Higgins, R., Vol. I, pp. 470, 471, Qs339, 340, 344; p. 472, Q348), and as it is an inorganic substance, a process employing it in solution is covered by claim 1 and not covered by claim 2. Sulphuric acid under certain conditions with one particular ore acts in solution as a mineral-frothing agent and is also an inorganic substance (Higgins, R., Vol. I, p. 471, Q345). A process thus using it would be covered by claim 1 and not by claim 2.

It is to be noted that the claims are not for *substances* but are for *processes*. The carefully selected terminology of the patent, both in the descriptive parts of the specification and in the claims, limits the scope of the patent to froth-flotation *processes involving the use of mineral-frothing agents in solution,* and by the descriptive part of the specification we are instructed as to the manner in which it may be determined whether a given soluble substance is capable or incapable of use in the process as a mineral-frothing agent, and we are warned that certain soluble substances, and moreover substances which when dissolved in water tend to promote froth formation, are not capable of acting as mineral-frothing agents. Claim 1 therefore includes within its scope froth-flotation *processes* involving the use of any and every soluble substance

which in solution acts as a mineral-frothing agent, and claim 2 every such process wherein such substance is an organic substance. These claims exclude from the subject matter patented by them all processes employing substances which do not dissolve and all processes employing substances which do dissolve unless such substances act in the process as mineral-frothing agents in solution.

The disclosure upon which is based this *wholly new classification of substances* and which first announced to the world this *wholly new and remarkable process*, comes well within the statute requiring an inventor to "file in the Patent Office a written description of" "his invention or discovery" "and of the manner and process of * * * using it, in such full, clear, concise and exact terms as to enable any person skilled in the art or science to which it appertains * * * to * * * use the same" (U. S. R. S. 4888); and this disclosure is followed by claims which "particularly point out and distinctly claim the part, improvement or combination which he claims as his invention or discovery" as required by the same statute.

Comparison of the Process of Patent No. 835,120 with the Process of the Patent in Suit, No. 962,678.

Generally comparing the process of the patent in suit with that of the first patent, No. 835,120, it is a fact that the only essential change in the things that are put into the pulp in the process of the patent in suit is that the agent is one which will go into solution in the water of the pulp instead of remaining undissolved therein. It is a fact that the same machines may be used in the process of the patent in suit as are used in the process of patent No. 835,120, and that the machines operate, as machines, in the same manner. But the process of patent No. 835,120 utilizes the well known quality of oil of coating or greasing the mineral and repelling the water; whereas the process of the patent in suit discards that idea and introduces an entirely new idea, viz., *modifying the qualities of the water itself*. Therefore it is obvious that the process of the patent in suit cannot be an improvement of the process of patent No.

835,120. Expressed in the language of the patent law, patent No. 835,120 does not in any manner dominate the invention in issue. No relation of genus and species exists. It is not the fact that any one practicing the process of the later invention would thereby infringe any claim of the earlier patent, and this is always the case where a later invention is an improvement of the earlier. The later invention here in issue is not an improvement of the earlier but a complete departure from it. The two inventions are distinct, the one (that of patent No. 835,120) utilizing the old and well known preferential affinity of oil for mineral over gangue, and the other (that of the patent in suit) departing altogether therefrom and entering upon and opening up a new and theretofore undiscovered field of invention. The invention in issue is a *pioneer invention. It utilizes for the first time dissolved substances as mineral-frothing agents with a new mode of operation thereby effected.*

The following comparison epitomizes the facts heretofore discussed.

The known physical differences between the operations of the two processes are as follows:

1. The process of 835,120 utilizes a minute amount of a water-repelling oil as a mineral-frothing agent and the preferential affinity of that oil for metalliferous mineral over gangue in an ore pulp, and in it the oil is *not dissolved* but is broken up into minute globules suspended in the water of the pulp which are disseminated throughout the water of the pulp so that they come in contact with the metalliferous mineral particles also suspended in the water of the pulp and coat these particles with a thin film of oil.

In the process of 962,678 a soluble mineral-frothing agent is *dissolved* in the water of the pulp; this agent does not and cannot exert preferential affinity for the metalliferous mineral over the gangue or coat the metalliferous mineral particles. It stays in solution in the water of the pulp throughout the whole operation of the process and acts to modify the water of the pulp.

2. In the process of 835,120 the oil-coated metalliferous mineral particles become attached to air bubbles which lift the oil-coated metalliferous mineral particles up through and out of the pulp and form upon the surface of the pulp a froth of oil-coated metalliferous mineral particles attached to bubble films.

In the process of 962,678 the water of the ore pulp is now a solution, and in this solution the uncoated metalliferous mineral particles are suspended. A much greater number of air bubbles forms in this solution including a multitude of much finer bubbles, and these air bubbles attach themselves to the uncoated metalliferous mineral particles and lift them up through and out of the pulp and form upon the surface of the pulp a froth of uncoated metalliferous mineral particles attached to bubble-films, the liquid in these films being a part of the solution in which the bubbles were formed.

3. In the process of 835,120, after the formation of the froth, practically all of the oil is in the froth as a coating upon the metalliferous mineral particles therein. In the impoverished pulp below there is practically only gangue and water. Of course the process is not perfect, and there is a trace of oil-coated metalliferous mineral left in the impoverished pulp.

In the process of 962,678 after the formation of the froth practically all of the dissolved mineral-frothing agent remains in the impoverished pulp. Only so much thereof is in the froth as is dissolved in the water of the films of the bubbles of the froth. The trace of metalliferous mineral that remains in the impoverished pulp in no degree adds to the amount of mineral-frothing agent in the pulp.

4. In the process of 835,120 after the froth has been removed it can be broken down and washed with water, but this merely sets apart the oil-coated metalliferous mineral particles from the gangue entrapped in the froth. Notwithstanding the washing with water the oil coating stays on the metalliferous mineral particles, and if these particles are washed and filtered

and then put back into fresh water and agitated and aerated the presence of the oil coating on the particles will reveal itself by causing formation again of a mineral-bearing froth with substantially the same recovery of metalliferous mineral particles in the froth as in the first operation. On the other hand the impoverished pulp is impotent to form again a mineral-bearing froth, and if fresh ore is added to it, with agitation and aeration, no froth will be formed.

In the process of 962,678 after the froth has been removed, if it be washed with water in the same way and filtered and then put back into fresh water and agitated and aerated, it is incapable of again forming a mineral-bearing froth. The water of the impoverished pulp on the other hand contains the dissolved mineral-frothing agent and may be used over again with fresh ore and without the addition of any mineral-frothing agent; and if the water of the films of the froth and the water of the impoverished pulp are separated and used with fresh ore and no added mineral-frothing agent, they will produce again, upon agitation and aeration, a mineral-bearing froth concentrate of substantially the same metalliferous mineral content as the first froth.

Additionally to the physical differences above enumerated the bubbles of the process of 962,678 have a greater ease of attachment to the metalliferous mineral particles, and the froth of the process of 962,678 is more copious and less persistent and does not so well carry oversized metalliferous mineral particles as the froth of the process of 835,120.

Both inventions are what are termed empirical inventions. That is to say, they were not the result of *a priori* reasoning. Rather they were stumbled upon in the course of extensive experimental investigations. They followed unexpected discoveries, true discoveries of theretofore unknown phenomena. They cannot even now be explained and from this it follows that they could not have been predicted. We do not know today why the physical forces act as they do. We only know that as a result of the action of the physical forces involved in the two different

processes different phenomena occur and different operations take place and different results are obtained.

And notwithstanding the magnitude of the interests at stake both in the use of these processes and in the efforts to destroy the patents for these processes, notwithstanding the researches of scientists and metallurgists the world over, the plaintiff and defendant came to this trial, at this late date, utterly unable to put forward satisfactory theories of the operation of the two processes. So far as the plaintiff is concerned, its witnesses faced that fact and frankly admitted it (Higgins, R., p. 476, Q372 and Court's questions; Chapman, pp. 559, 560, Q162). Defendant's witnesses put forward partial theories, which, as we show, are contradicted by facts, and Dr. Bacon frankly tells us how little the scientist relies upon theories of that character. He says (R., p. 343, Q16):

> "I might say that investigators, as they go along usually get what we call theories, and the theory is sometimes useful to tie up to, and as soon as the facts don't tie up any more, then it is discarded and we get another theory. But at that time we were working on a theory that electrical forces were the forces, perhaps, which came into play and which caused flotation. We thought at that time that we had some evidence for that."

Since we cannot explain the actions of the physical forces which take place in froth-flotation processes, whether that of patent 835,120 or that of 962,678, no complete detailed comparison of them can be made. Therefore we should accept other evidence in addition to that of the things apparent to the eye or capable of being shown by demonstration, as establishing the fact that the processes are substantially different. Such evidence is afforded by the fact that the process of the patent in suit (either alone or conjointly with the process of patent No. 835,120) has solved the problem of the concentration of that great body of American copper ores known as the porphyries, while the process of patent No. 835,120, when not conjointly used with the process of the patent in suit, failed to solve that problem. We should also accept the fact that all suc-

cessful commercial air-froth flotation operations of today utilize the process of the patent in suit (either alone or conjointly with the process of patent No. 835,120), whereas before it was invented and when the process of patent No. 835,120 alone was known and used, the successful operations of air-froth flotation ore concentration were confined to those carried on in Australia with zinc-lead ores. These outstanding, practically undisputed facts, it is submitted, conclusively demonstrate that the mode of operation of the process of patent No. 835,120 and the mode of operation of the process of the patent in suit must be and necessarily are different. We do not know, and it is not at all necessary that we should know, why this is so. As was said by this Court in *Diamond Rubber Co.* v. *Consolidated Rubber Tire Co.*, 220 U. S. 428, at pp. 435, 436:

> "A patentee may be baldly empirical, seeing nothing beyond his experiments and the result; yet if he has added a new and valuable article to the world's utilities, he is entitled to the rank and protection of an inventor. And how can it take from his merit that he may not know all of the forces which he has brought into operation? It is certainly not necessary that he understand or be able to state the scientific principles underlying his invention, and it is immaterial whether he can stand a successful examination as to the speculative ideas involved."

The crux of the question of patentable novelty in the process of the patent in suit is whether or not it merely uses an equivalent for the undissolved mineral-frothing agents prescribed in patent No. 835,120 in the process of that patent and thereupon merely achieves the same result by the same mode of operation. In approaching this question care must be taken not to confuse what is meant by the mode of operation of a process. It does not mean machinery or the mode of operation of machinery. It does not mean mill manipulation. It does mean the way in which the result is accomplished by the use of the prescribed process. Therefore when we speak of the process of patent No. 835,120 and the process of the patent in suit and the differences between them, we mean differences with respect to the mode of operation of the processes and by

that we mean differences which proceed in the pulp and in the froth whereby the result sought is achieved, and we do not mean the machinery used or the mill manipulation. Therefore it does not clarify the matter at all to say that the mode of operation is the same because the same machines mechanically operated in the same manner and subjected to the same mill manipulation may be utilized in carrying out the two processes, nor does it clarify the matter to say that a mineral-bearing froth is achieved in each case.

Using the term properly, the inquiry should be: Is the mode of operation, the law or principle of action, which proceeds in the process of the patent in suit the same as the mode of operation, the law or principle of action, which proceeds in the process of patent No. 835,120? We submit that the evidence as to the manifest physical differences and as to the differences that are shown by demonstrations and as to the differences in the practical results achieved establish beyond peradventure that the modes of operation of the two processes, the laws or principles of action by which they proceed, are and must be substantially and fundamentally different.

It may be stated that the actions of the physical forces which take place in the pulp and in the froth are unknown, and it is impossible to give the reason why in the process of patent No. 835,120 the oil selectively coats the metalliferous mineral particles and the air bubbles selectively attach themselves to the oil-coated metalliferous mineral particles and form a persistent mineral-bearing froth, and why in the process of the patent in suit, the water, modified by the mineral-frothing agent dissolved in it, causes the production of a much greater number of finer bubbles which selectively attach themselves and even with greater ease to the uncoated metalliferous mineral particles and form a more copious but less persistent mineral-bearing froth. Since we do not know in full detail what takes place in either process or why it takes place, we may well consider the differences in what the two processes will do. The fact therefore that the invention of the patent in suit solved the problem of the froth-flotation concentration of the great

body of copper ores and that the process of patent No. 835,120 failed alone to do this is, we submit, convincing evidence of a very substantial and a very practical and a very highly useful difference between the two processes.

Commercial Operations of Mineral-Froth Flotation Before and After the Invention of the Patent in Suit, No. 962,678.

Commercial operation under patent No. 835,120 began in Australia in 1905 (R., Vol. I, p. 551, Q77). The operations were large, including six plants (Q79) and were highly successful financially (R., Vol. I, p 554, Court's question). The great dumps of Australia, the reject of water concentration (Higgins, R., Vol. I, p. 459, XQs269-271) were exclusively treated by one of the plants and four of them treated both dumps and current tailings of water concentration (Chapman, R., Vol. I, p. 553, Q91). In all the plants oleic acid was used in the proportion of 1½ to 2 pounds per long ton of ore (pp. 551, 552, Qs80-82). These were the conditions when Mr. Chapman left Australia about June, 1908 (p. 551, Q78). Mr. Higgins left England for Australia in August, 1908, and stayed in Australia until about March 10, 1909 (R., Vol. I, Stipulation, p. 600, first paragraph) and thus carries the story of Australian operations beyond February 1, 1909, the record date of the invention in issue. His description of the operations as then carried on in Australia (R., Vol. I, p. 459, Qs264-269) is a description of the practical use of the process of patent No. 835,120—the practical use of the froth-flotation process—at about the time that the specification of the patent in suit was written. Oleic acid was the only mineral-frothing agent used and sulphuric acid was used with it as a gangue-corrective.

Then in 1908 and 1909 the invention in suit was made and in 1910 patent No. 962,678 issued.

The next reference in the evidence to practical operations of froth flotation is that at the Saxbergets Mine in Sweden in or about July, 1912 (Chapman, R., Vol. I, p. 561, Qs175, 176). The metallurgical art had then been enriched by the knowledge of the invention of the patent in suit, so that it was then a known

fact that soluble substances could be used as mineral-frothing agents. Mr. Chapman selected a local wood-tar which had a soluble as well as an insoluble mineral-frothing constituent. In testing it he followed the instructions of patent No. 835,120 and the instructions of the patent in suit. The plant was operated with this local wood-tar and thereby conjointly carried on the process of patent No. 835,120, and the process of the patent in suit. This has been referred to by defendant's counsel as a striking example of what a metallurgist would do if he had only patent No. 835,120 before him, whereas the fact is that Mr. Chapman had knowledge both of that patent and of the patent in suit when he selected and used this local wood-tar.

Infringement in the *Hyde* case began late in 1911 and had to do with zinc ores with oleic acid as the agent. The infringement in the *Butte & Superior* case followed that in the *Hyde* case with the same ore and involved the conjoint use of the process of the patent in suit and of the process of patent No. 835,120.

The great use of the invention of the patent in suit, No. 962,678, has been with porphyry copper ores. That invention solved the problem of the froth-flotation concentration of copper ores generally and particularly of porphyry copper. George A. Chapman, whose experience in practical work of the froth-flotation process has extended over the past 23 years (R., Vol. I, p. 551, Q73) and who has installed this process in many places the world over (Q74) testifies that in all his experience in froth-flotation he has never known of any instance where porphyry ores have been successfully treated with an insoluble mineral-frothing agent alone (R., Vol. I, p. 560, Qs164, 165) and that a wholly soluble or a partly soluble mineral-frothing agent has always been used (Q165). He briefly outlines the story of the first installation and use of the froth-flotation process on porphyry ores, this being at the Inspiration Mine, Arizona, in January, 1913, mainly with cresol as the mineral-frothing agent (R., Vol. I, pp. 554, 555, Qs98, 107). This soluble mineral-frothing agent cresol is a homologue of phenol (Taggart, R., Vol. I, p. 240, Q109) and therefore included within the homologues of phenol named in the patent in suit (Specification,

p. 1, line 34). These successful operations brought about the installation of a larger test plant, and eventually of a large mill with a capacity of treating from 16,000 to 18,000 tons per day (R., Vol. I, p. 555, Qs107-110). It may be noted that the final types of apparatus used at this great mill were pneumatic machines, partly of the standard Callow type, such as defendant here uses, and partly what is known as the Inspiration cell, which also has a porous canvas bottom and is of the same general type as the Callow cell (R., Vol. I, p. 556, Qs121-124).

All of this work at the Inspiration Consolidated Copper Company has been under license from plaintiff and its predecessors since April 10, 1913 (Pltff.'s Ex. 18, Stipulated Roberts' Affidavit, R., Vol. II, p. 717), a few months after the first test plant was installed. It will be noted that this was the first license granted to a porphyry company. It will be noted also that the total treatment of that porphyry ore at that mine has amounted to 30,303,675 tons (R., Vol. II, p. 723).

The soluble mineral-frothing agent cresol was first used in these successful operations. This led to a search for cheap sources of cresol, and such cheap sources were found in the cheap coal-tar and wood-tar products which can be manufactured so as to contain in sufficient quantities cresol, phenol and their homologues. These substances also contain insoluble oils which were found to assist in the operations. Hence followed the conjoint use of the process of the patent in suit and of the process of patent No. 835,120.

Confirmatory of the difficulty of the problem of concentrating porphyry ores by flotation, defendant proved that on July 1, 1914 (Bacon, R., Vol. I, p. 339, Q6), eighteen months after the commencement of the work at Inspiration, a research Fellowship was founded at the Mellon Institute of Industrial Research in Pittsburgh, and that those who founded the Fellowship advised the Institute (Bacon, R., Vol. I, pp. 339, 340, Q7):

> "that while flotation had been started in this country on certain types of ores, particularly zinc ores, that it was not possible to float the great body of ores in this country, that is particularly the copper ores."

Again he says that virtually all of the work of research was with copper ores "because we were trying to float the hard ones" (p. 344, Q18). He also admits in cross-examination that he was advised of what was being done at the Inspiration mine in treating porphyry ores by flotation and says that it was not the impossibility of flotation of copper ores that he referred to but the impossibility of doing it profitably (pp. 350, 351, XQ46). Obviously no problem in the metallurgical art is solved until the operation can be carried on profitably.

Another remarkable example of the use of the process of the patent in suit is at the Anaconda mine in Montana. Here the copper license is dated February 1, 1915 (R., Vol. II, p. 714) and Mr. Chapman spent some two or three years in installing the plant (R., Vol. I, p. 557, Qs138, 140). This plant has a capacity in copper ore of treating between 11,000 and 12,000 tons a day by flotation (Qs141-143). A zinc license was also taken out on February 14, 1918, and a zinc mill installed with a capacity of treating about 2,000 tons of ore per day (R., Vol. I, p. 558, Qs144, 149). The returns of this Company show that under these licenses 20,305,726 tons of copper ore have been treated (R., Vol. II, p. 723) and 1,649,617 tons of zinc ore (p. 722).

Another remarkable feature of these great mills was the utilization of the soluble mineral-frothing agent kerosene acid sludge, which was a waste product before it was used in flotation (R., Vol. II, p. 558, Qs150, 152). This it will be noted is given as one of the principal reagents used by the Anaconda Company both for copper ores and zinc ores (R., Vol. II, p. 696).

Among the other licensees whose tonnage treated exceeds 1,000,000 are the Phelps Dodge Corporation, whose license is dated December 31, 1917 (R., Vol. II, p. 718) and who have treated 1,980,566 tons of porphyry ores (Pltff.'s Ex. B, p. 93) under its license, and the Engels Copper Mining Company, whose license is dated June 18, 1914 (p. 716) and who have treated 1,892,036 tons of ore under their license (p. 722). Several other licensees have treated under license amounts in the neighborhood of a million tons.

But the general recognition of plaintiff's patent in suit came slowly and only after extensive litigation. Among the porphyries the Utah Copper Company, Ray Consolidated Copper Company, Chino Copper Company and Nevada Consolidated Copper Company took out licenses as of January 1, 1922, and their combined tonnage treated, both that before they were licensed and that under license since their recognition of the patent, amounts to 86,070,722 tons (R., Vol. II, p. 723). In this class of mining companies who litigated first and then settled is included the Miami Copper Company, whose license is as of January 1, 1922, and whose aggregate tonnage, both before and after the license, is 13,133,998 (*ib.*).

The Butte & Superior Mining Company is another of the mines which litigated for years and then took a license. It has a zinc license and a copper license, both as of January 1, 1922 (R., Vol. II, p. 715) and its total tonnage treated is 2,979,585 (R., Vol. II, p. 723).

These individual figures are sufficiently large to show the tremendous use of the invention, and it may be noted, as appears from the list of reagents (R., Vol. II, p. 712) that soluble mineral-frothing agents are present in all of these operations even where zinc ores are treated.

By reason of the variant methods in which the 144 licensees in the United States of the plaintiff have made their returns, it is impossible to give the aggregate figure of the tonnage of ore treated which has paid tribute to the patent in suit. The total tonnage, however, of those licensees whose returns are of tons of ore treated has been about 170,000,000 (R., Vol. II, p. 725) and where the returns were in concentrates produced the tons of concentrates thus produced were more than a million tons, and where the returns were in the weights of metals recovered the aggregate was nearly 240,000,000 pounds of lead, zinc, copper, gold and silver recovered. These colossal operations were made possible only by the invention of the process of the patent in suit. This fact justifies liberal treatment of the patent on the issues both of validity and scope (*Infra,* pp. 122, 123).

In these practical operations the use of acidified pulps has not played a large part. The reagents used by 80 of the 144 licensees of the plaintiff are given (R., Vol. II, pp. 696-712) and only seven of them acidify their pulps, in each case with sulphuric acid. These include Anaconda (p. 696), Butte & Superior (p. 699), Elm Orlu, for its zinc ore and not for its copper ore (p. 702), Utah Copper Co. (p. 711) and three smaller concerns (pp. 700, 705, 707). This acidification of ore pulps, first disclosed in the patent to Everson No. 348,157 of 1886, forty-three years ago, and standard in the practical art at the time of the invention in issue, like the heating of pulps referred to by Professor Bacon (R., Vol. I, p. 347, Qs33-35), has been largely done away with in the development of the art and the extension of the use of the process in suit to *very many different ores*. The Australian operations of the froth-flotation process used sulphuric acid (Higgins, R., Vol. I, p. 459, Q267), and great litigations were fought in England and Australia wherein the owners of the Elmore patents for a bulk-oil or oil-buoyancy process employing an acidified pulp, endeavored to establish the fact that the use of sulphuric acid in the froth-flotation operations employing oleic acid as the oil, was an infringement of the corresponding Elmore British patent No. 6519 of 1901 (25 R. P. C. 743, 744) and Elmore Australian patent No. 11,307 of 1901 (31 R. P. C. 210-212), both patents being essentially for the use of acid to enhance or promote the selective action of oil in an ore-concentration process. It was also suggested in the early disclosures of the art that alkalies could be used to enhance or promote selectivity, and it has been found in practice that in a few instances alkalies can be so used. It has, however, been found that in the greater number of instances it is not necessary to use either acid or alkali. Of the 80 licensees of the plaintiff whose reagents appear, it happens that 14 use alkalies, just twice as many as use acid, and, of these 14, 6 use lime, as does the defendant in two instances with X-cake, as does the defendant. Again, although the absence of both acid and alkali brings about a neutral pulp, six of plaintiff's licensees use a neutral agent. These substances, whether acid, alkaline, or neutral, are well characterized by

Mr. Chapman as gangue-correctives (R., Vol. I, p. 558, Q153; pp. 559, 560, Qs156, 159-163).

Among the 80 licensees 53 do not use any gangue-correctives at all, which is roughly two-thirds. Among the remaining one-third, just about one-quarter, or about 8% of the whole, use an acid gangue-corrective.

Thus there has been enormous use of the process of the patent in suit, most largely conjointly with the process of patent No. 835,120. For the flotation of porphyry ores the process of patent No. 853,120 is, in the majority of cases, greatly advantageous, but the process of the patent in suit No. 962,678 is in all cases absolutely necessary.

The revolution wrought in the practical art by the advent of the process of the patent in suit not only demonstrates the utility of that process, but evidences also its novelty and inventive character; and more specifically it evidences most conclusively that patent No. 835,120 did not disclose to the public the process of the patent in suit.

Errors of the Circuit Court of Appeals in Dealing with the Question of Anticipation of the Patent in Suit, No. 962,678, by Patent No. 835,120.

These errors which are numerous in detail arrange themselves chiefly into two classes, namely, first, that the agents in solution of patent No. 962,678 really preferentially coat the mineral particles like the oleic acid of patent No. 835,120 and, secondly, that the oleic acid of patent No. 835,120 really dissolves in part in the water of the pulp and that that forms the froth; and we will first consider the errors under those two headings and will later consider further errors that do not group themselves under either heading.

The Error of the Circuit Court of Appeals for the First Circuit in its Conclusion that the Mineral-Frothing Agents in Solution of the Patent in Suit No. 962,678 really preferentially coat the mineral particles as the oleic acid and other equivalent oily substances of Patent No. 835,120 do.

The Circuit Court of Appeals in the instant case apparently held that a soluble agent would coat the metalliferous particles

and on agitation produce a froth or scum for they say (R., Vol. I, p. 650):

> "The plaintiffs undertook to refute the disclosure of the New Zealand and the United States patents [Nos. 835,120, 777,273 and 777,274],—that a soluble agent would coat the metalliferous particles and on agitation produce a froth or scum,—by an experiment which they made; but the experiment amounted to nothing in the absence of the deduction drawn therefrom by the plaintiffs' expert witness, which deduction was contradicted and substantially refuted by the testimony of the defendant's witness."

Now the experiment or experiments here referred to speak for themselves. They were parallel experiments made first with the process of patent No. 835,120 using oleic acid as the agent and then with the process of patent No. 962,678 using phenol as the agent, and in each case the resulting froth concentrate was tested for the presence of a coating on the mineral particles.

The mineral particles resulting from the process of patent No. 835,120 were found to have froth-forming coatings upon them whereas mineral particles resulting from the process of patent No. 962,678 were found to entirely lack any coating.

These experiments we will now describe in detail.

The mineral particles in the froth resulting from the process of patent No. 835,120 still have a froth-forming coating upon them after separation from the water of the pulp and this coating is sufficient and effective to repeat the froth-formation process with fresh water without the addition of any more oleic acid.

The fact that the process of this patent No. 835,120 produces a froth of oil-coated mineral particles and that the oil-coated particles of the froth, after thorough washing with warm water, could be sunk and reagitated and would without any further addition of oleic acid reproduce the froth, was shown to the trial Court by the demonstration made by Mr. Higgins at Boston in what was described as the first experiment (R., Vol. I,

pp. 395-397), except that the latter part of the experiment was not carried on because defendant's counsel conceded that it would happen and would be "the same thing over again" (p. 397). And Mr. Higgins further testified that he had performed this complete experiment several times (pp. 447, 448, Q198), that the second froth was of the same nature and contained practically the same amount of mineral as the first (Q199) and that the frothing agent for the second agitation for producing the second froth came from the oily coating on the surfaces of the metalliferous particles (Q200), and that the oil was "practically completely removed from the pulp liquor" by the froth (p. 451, Q215).

Professor Taggart suggested by way of criticism of the experiment that the oleic acid was not attached to the metalliferous mineral particles but was present in detached particles of oleic acid upon the filter paper (R., Vol. I, p. 583, Q449), although he afterwards admitted that the solid matter, to wit, the metalliferous particles on the filter paper, was coated with oleic acid (R., Vol. I, p. 586, XQ451). He testified that if that concentrate had been shaken up with water and then allowed to stand, globules of oleic acid would have been visible (XQ458). He said he had done this, although not with the particular material which Mr. Higgins used (XQ459) and admitted that if the material were shaken you would get a mineral-bearing froth, but not very much (XQ462) (thereby contradicting the admission of defendant's counsel which the Court said must stand as made) and that the globules of oleic acid could be seen in the pulp between the settled solids at the bottom and a little layer of froth on top (XQ463).

Thereupon Mr. Higgins was recalled and contradicted these statements as to the presence of free oleic acid under the conditions stated (R., Vol. I, pp. 591, 592, Qs796-800). He further testified as to very careful experiments on his part wherein he had sunk the froth under such circumstances as to leave a clear surface of water to which free oleic acid would, of course, float, and then tested by a most delicate experiment which is generally accepted to indicate the presence of a trace of oil one molecule thick, which clearly indicated there was no possible free oleic

acid present; and he further states that if there was any free oleic acid in the froth it could be seen as globules by examination with a microscope, and that he had done this several times and had never seen any globules of oleic acid (R., Vol. I, p. 593, XQ805).

It may be noted that the Circuit Court of Appeals declined to witness an offered repetition of this test.

The mineral particles in the froth resulting from the process of patent No. 962,678 have no coating upon them after separation from the water of the pulp and upon re-agitation with fresh pulp water and without the addition of further frothing agent no mineral froth is formed and everything sinks to the bottom.

This was called the second experiment. In it the actual operations of the process of the patent in suit were shown to the trial Court in the Boston Demonstrations (the repetition of which was offered to the Judges of the Circuit Court of Appeals and declined by them) and not only by repeating defendant's infringing operations on a small mill scale, but also by an operation in a Gabbett mixer with a rotating agitator, following a specific example of the patent. The agent used was one of the organic substances named in the patent, phenol (R., Vol. I, pp. 398-401). The complete experiment involved also the removal of the froth, breaking it down and thoroughly washing it with warm water, and then returning the filtered and washed concentrate to the Gabbett mixer with the proper amount of acidulated water and re-agitating it, when, as stated by Mr. Higgins (R., Vol. I, p. 398):

> "it will be found that the froth will not be re-formed, that practically the whole of the concentrates will be left in the bottom of the Gabbett."

In other words the concentrate, after the mineral-frothing agent in solution had been separated from it by washing, was incapable of again forming a froth with fresh agitated pulp water. There was now no mineral-frothing agent present, either

in solution in the water or as a coating on the metalliferous mineral particles.

Since defendant's counsel stated his willingness to agree that everything would happen as Mr. Higgins had said it would happen (p. 399), only the first part of the experiment, to wit, the first agitation and froth formation, was then actually carried out. This experiment followed the other experiment, called the first experiment described above, which was an exact carrying out of the example of patent No. 835,120. In the two experiments everything used was the same except the mineral-frothing agent, which in the first experiment was the undissolved mineral-frothing agent oleic acid and in the second experiment was the dissolved mineral-frothing agent phenol, each in the small quantity claimed in the respective patents.

The two machines in which the experiments were carried out were identical, and the manipulations of these machines were identical. The essential difference was in the mode of operation of the process—the way the physical forces acted in the pulp to form a mineral-froth and so separate out the mineral and concentrate the ore. A difference in the appearance of the resulting froths was plainly apparent and was described by Mr. Higgins (R., Vol. I, p. 401).

Mr. Higgins further testifies, in regard to this and the other comparative demonstrations, as to the identity of the two machines (R., Vol. I, p. 448, Q201), and as to the showing made by these two experiments, as follows (R., Vol. I, pp. 448, 449):

> "Q204. What do these experiments demonstrate to you or show you?
>
> A. They show me that in the first experiment the mineral-frothing agent coats the metalliferous particles and that in the second experiment the mineral-frothing agent does not coat the mineral particles."

These experiments demonstrated to the trial Judge who witnessed them, and they would demonstrate to any other fair-minded person who witnessed them, that the mineral-frothing agents in solution of patent in suit No. 962,678 do not coat the mineral particles.

Mr. Higgins also testified to a wide range of experience of the same general character, demonstrating the same fact as will appear under the next heading.

The mineral-frothing agents of the process of patent No. 962,678 stay wholly in solution.

Mr. Higgins also affirmatively demonstrated that the soluble mineral-frothing agents stay in solution. He was asked if he had made other tests of the same general character as his second experiment in Boston with soluble mineral-frothing agents where the concentrate was washed and subjected to a second agitation in fresh water without the addition of any more frothing agent (R., Vol. I, p. 448, Q202) and he replied that he had and that the results in these experiments of the second agitation were as follows (XQ203):

> "The concentrates, instead of floating to the surface in the form of a froth, are practically wholly sunk in the liquid, only a minute quantity of mineral coming to the surface."

He then testified as to the class of experiments of the same general character as the second as follows (R., Vol. I, p. 449):

> "Q205. And referring now to the class of experiments of the same general character as the second, with soluble mineral-frothing agents, you say that these soluble frothing agents do not coat the mineral particles. What happens to the soluble mineral-frothing agents?
> A. They stay in solution."

The wide range of these experiments is then described (XQs. 206-208), including experiments with defendant's mineral-frothing agent alpha-naphthylamine. and he testifies that with this soluble mineral-frothing agent he had used the defendant's ore and the Miami Copper Company ore (Q209).

Asked whether he had described all of these experiments he said he had not, and then proceeded to describe the series supplementary to the particular kind of demonstration made to

the Court, to wit: experiments affirmatively showing that the soluble mineral-frothing agent was actually present in solution in the water of the pulp which remained with the gangue after the removal of the mineral-bearing froth which had been formed by the action of this soluble mineral-frothing agent (R., Vol. I, p. 449, Q210). Here, after formation and separation of the froth, he separated the pulp water from the froth and from the tailings by filtration. Two tests were made to obtain a sufficient amount of such pulp water and then with this in the right amount as the pulp water the experiment of agitating the mixture with fresh ore was repeated without adding any more mineral-frothing agent. As to these experiments Mr. Higgins testifies (*ib.*):

> "In every case I find that the ore floats with as much readiness and giving practically the same recovery as in the first treatment."

Mr. Higgins also describes a similar experiment with defendant's ore and frothing agent, carried on in a subaeration machine (R., p. 450, Q213). Machines of this type are elsewhere described in the record, for example, the Hebbard subaeration machine tested at the Inspiration mill (Chapman, R., pp. 555, 556, Qs115-120) with air flowing in at the bottom, impellers at the bottom and the froth taken off the top of the same vessel. This type of machine was also referred to in the quoted testimony of Professor Taggart which he admitted he gave in the *Butte & Superior* case (R., Vol. I, p. 302, XQ376, quoting XQ135 from *Butte & Superior* case). Two laboratory machines of this type were also exhibited in operation at Boston in what is called Mr. Higgins' third experiment, modified only in that they had no launders at the top for removing concentrates (R., Vol. I, pp. 401, 402, Qs46-48). Generally in these machines air enters at a pipe through the bottom, the revolving agitator above that pipe breaks up the air into small bubbles in the presence of a mineral-frothing agent, baffles above the agitator prevent the formation of a vortex, and a layer of froth is formed on the top of the liquid in the same vessel during the agitation and is normally overflowed during the agitation.

In a machine of this type Mr. Higgins carried on experiments as follows (R., Vol. I, p. 450, Q213): He used defendant's ore, defendant's mineral-frothing agent and lime, and obtained a froth and removed it. He then filtered the concentrates and tailings to separate the solution. He repeated the test to assure a sufficient quantity of the separated used solution, and then, with the proper quantity of the separated used solution, repeated the operation without adding any alpha-naphthylamine and obtained a froth of concentrates and removed the froth as before. The froth of the first treatment and the froth obtained with the used solution in the second treatment were assayed and the assays were substantially the same. In this case also he took some of the solution before use and some of the solution after the second use and by chemical color tests demonstrated (R., Vol. I, p. 450, Q213)

> "that substantially the whole of the alpha-naphthylamine was in the solution that had been used twice."

He further says that the chemical color determinations that he used give a somewhat rough determination, but indicated that the amount of alpha-naphthylamine in solution had not materially decreased in quantity (Q214). He then testified as follows (R., Vol. I, p. 451):

> "Q215. Now, putting it on the basis of consumption of mineral-frothing agent, let us say, given a practical operation, and the concentrates overflowed, what happens in the case of an insoluble mineral-frothing agent?
>
> A. The insoluble mineral-frothing agent coats the metalliferous particles and is practically completely removed from the pulp liquor. Thereafter it is of no further use in the process, except when the concentrates are retreated for the purpose of raising the grade.
>
> Q216. Now, upon the same basis, what happens with the soluble mineral-frothing agents?
>
> A. The soluble mineral-frothing agent stays in the solution or circuit liquor, as we call it, and is collected and used over again, when it proves to be a useful mineral-frothing agent, without adding any further quantity.
>
> Q217. For a fresh lot of ore?
>
> A. Yes, sir.

By the Court:

Q218. Can that be done indefinitely?

A. No, sir. The action of the air on a substance, particularly such as alpha-naphthylamin, oxidizes or decomposes the material. That decomposition is especially active in the presence of sunlight. All of these pulp liquors go from the circuit or filtering apparatus down to a pond which is always exposed to the light. This undoubtedly brings about decomposition of the substance, as I say particularly of a substance such as alpha-naphthylamin, and results in substantial loss, so that even though the circuit liquor is returned to the mill, fresh quantities of alpha-naphthylamin have to be added."

It may be noted that the demonstration and other experiments that Mr. Higgins made showing that the filtered and washed froth concentrate obtained with a soluble mineral-frothing agent in solution will not, when put into fresh water and re-agitated, produce a mineral-bearing froth, are confirmed by experiments which defendant's expert Professor Taggart admitted on cross-examination that he had made and published (R., Vol. I, p. 309, XQ414). The publication expresses Professor Taggart's theories, but it also states the facts. The facts are that he obtained a mineral-bearing froth with a tar acid (which would be phenol, cresol or other homologues), that the concentrate froth was drained by filtration and then agitated with a fresh amount of water, and that "no froth at all was produced." This confirmed the conclusion that the mineral-frothing agent stayed in solution and did not coat the mineral particles, but since such a conclusion was destructive of Professor Taggart's theories, he evolved another theory to explain this observed and admitted fact. This theory of Professor Taggart is that the soluble mineral-frothing agent was so firmly attached to the metalliferous mineral particles that it would not come off in the second operation, or act in any way in the second operation, so that the second operation was carried on as though no mineral-frothing agent whatever were present. In his publication Taggart proceeded to say that an amount of the tar acid equal to the amount which he assumed was attached to the mineral par-

ticles, produced an appreciable froth when in solution in water with no solid material present. Just exactly how he determined what was the amount of what he calls "adsorbed oil" which, according to his theory, was so firmly attached to the mineral that it would not function in the process, he does not anywhere say.

In re-direct he attempts an explanation (R., Vol. I, p. 312, RDQ425) and puts forward his theory and says:

> "the second part of the experiment was just to show that if we could have gotten the material that was adsorbed onto the sulphides off, there was enough of it there to froth."

Apparently therefore he could not get it off and did not get it off and since his theory assumed that it went on, he assumed because it did not come off that it was still on, a species of logic by which an original unbased assumption is sought to be strengthened by a second unbased assumption. It is a mere speculative theory that is wholly immaterial to any issue here. But it greatly misled the Circuit Court of Appeals for the First Circuit.

Professor Taggart also testifies rather indefinitely about using over again the solutions from which mineral-bearing froths produced by mineral-frothing agents in solution have been separated, but *admits the fact that you can use them over again and get a froth,* and says that there is a certain amount of soluble mineral-frothing agent taken off every time (R., Vol. I, pp. 307, 308, Qs397-403). It is, of course, a well-known fact that always in the handling of liquids there is a slight loss. When the liquid is poured out it adheres more or less to the surfaces of the walls and bottom of the vessel. There is not the slightest indication that he carried on these experiments in the careful manner that Mr. Higgins did so as to obviate any effect from these losses by doing the experiment twice and then taking from the total amount of solution the required amount for the second agitation and froth formation.

There is other evidence on this subject adduced by the defendant in a statement appearing in the alpha-naphthylamine patent

under which defendant attempts to justify its infringement, to wit, the Corliss patent No. 1,228,183 of May 29, 1916. This patent is Defendant's Exhibit 126 (R., Vol. II, p. 1222) and the statement is as follows (lines 65-71):

> "the circuit water recovered from the concentrate and even that recovered from the tailings contains notable amounts of alpha-naphthylamin which can thus be returned to the process with resulting economy in the amount required to be added for subsequent operations."

This statement may be contrasted with the testimony of defendant's other expert, Dr. Bacon, on the subject. Dr. Bacon's mental processes are troubled by the same speculative theory that is put forward by Professor Taggart. He starts off by saying, relative to the cost of alpha-naphthylamine (R., Vol. I, pp. 344, 345, Q21), that "we" (and "we" may be presumed to mean Mr. Corliss and possibly others and himself) "were rather worried about the thing from the commercial standpoint," i.e., the cost of the alpha-naphthylamine, and further

> "and it seemed to us that you ought to be able to return that circuit water and add extremely little more, or virtually no more, X-cake and make another float, and so on, and thus use very little. But we found that that was not the case."

This statement of Dr. Bacon exactly contradicts the above quoted statements of Corliss in the published patent.

Dr. Bacon proceeds and says that "we" reached the conclusion that the X-cake "was adsorbed against the ore particles and principally against the mineral particles." He was asked whether he made any quantitative determinations (R., Vol. I, p. 345, Q25). He answered:

> "We tried to. We got some figures. *I do not know how accurate those figures are,* because you will understand that in any of this work, where you are trying to measure the amount of adsorption on surfaces, you are dealing with extremely minute quantities of substances, and the methods for measuring such extremely minute

> quantities of substances have not been developed to the extent that we would like."

He then further says that there was about ten times as much of the X-cake adsorbed on the sulphide surface as on the gangue surface. He further says (R., Vol. I, p. 346, Q28):

> "We made experiments like this:—We took some of this material on which the X-cake had adsorbed and we washed it thoroughly with water, so it was not a question of simply adhering solution, and then we dissolved the X-cake off with alcohol, and then we made chemical test to determine that it was X-cake."

He did not give the figures until cross-examination, and then it appeared that on the sulphide or metalliferous mineral he or his experimenters had found 0.00025 grams, and on the gangue 0.000025 grams. These figures in the first instance represent twenty-five one hundred-thousandths of a gram, and in the second instance twenty-five one-millionths of a gram. Having in mind that a gram is approximately one four-hundred-and-fiftieth of a pound (R., Vol. I, p. 365, XQ118) the minuteness of the character of this determination may be to some extent appreciated. Roughly the first figure is a half of a millionth of a pound and the second figure is a twentieth of a millionth of a pound.

These determinations, in which the witness himself expressed no confidence, are immaterial and of no probative value.

The demonstrations and oral evidence above fully reviewed, establish conclusively that when a mineral-frothing agent in solution is used in a froth-flotation process of ore concentration, the mineral-frothing agent stays in solution and does not coat the metalliferous mineral particles, in contra-distinction to what occurs when a mineral-frothing agent is used which remains undissolved and coats the mineral particles, as in the process of patent No. 835,120.

The trial Judge who heard the evidence and saw the demonstrations accepted this fact as proved. He says, comparing the process of patent No. 835,120, which he refers to as the first patent, with the process of the patent in suit (R., Vol. I, p. 620):

> "But the principle of action,—so far as it is known,—involved in the process in suit, is not the preferential affinity of the frothing agent used for the mineral particles or the coating of those particles, or the attachment of air bubbles to coated particles, as in the first patent, because the frothing agent goes into solution without coating either mineral or gangue, and the law of attraction and attachment of air bubbles to oil-coated mineral particles cannot apply. The process in suit, as it is put by counsel for plaintiff in their brief, 'proceeds by reason of the peculiar character of the air bubbles produced in water, modified by the presence of the dissolved mineral-frothing agent employed, and by reason of the attraction and attachment of such air bubbles for uncoated metalliferous mineral particles'."

The Circuit Court of Appeals for the First Circuit in support of their erroneous conclusion cited a certain "adsorption theory" advanced by defendant's expert witnesses and said (R., Vol. I, p. 650):

> "Then again, the disclosure of these two prior art patents [patent No. 835,120 and the New Zealand patent No. 19,633],—that agents having a preferential affinity for metalliferous matter coat the mineral particles with a slight film,—is supported by the adsorption theory presented in evidence through defendant's witness Taggart, that such agents, though in solution, will attach themselves to and slightly coat the mineral particles."

The theory of defendant's witness Taggart that mineral-frothing agents in solution come out of solution at the surfaces of the mineral particles and attach themselves to and slightly coat the mineral particles, although completely discredited by the evidence, was accepted by the Circuit Court of Appeals. We shall now consider that theory.

The adsorption theory.

Judge Peters, in his opinion commented upon the evidence as to the phenomena of adsorption in comparing the process of the patent in suit with the process of patent No. 835,120, just prior

to expressing the conclusion that mineral-frothing agents in solution stayed in solution in the operation of the process and did not coat the metalliferous mineral particles. He said (R., Vol. I, p. 619):

> "Into this field, with the process of the first patent as a part of the prior art, came the patentees of the second patent,—the patent in suit,—with an undoubted improvement; a process not dependent upon the oily coating of the mineral particles but utilizing a hitherto unknown property of mineral-frothing agents in solution to form air bubbles which attract and attach themselves to the uncoated and unoiled mineral particles. It should be said, however, that the defendant attacks the accuracy of the above general statement and maintains that it is not true that in the process of the second patent the mineral-frothing agent in solution forms bubbles which attach themselves to uncoated mineral particles. It says that, while the frothing agent goes wholly into solution in the water of the 'pulp,' a small part of it comes out again by 'adsorption' and does coat, minutely, the mineral particles,—so that it is the same process with a different agent. This is a region of disputation where experts and scientists occupy the field alone. They have battled valiantly, but with the result that I cannot say that I am convinced that the 'adsorption' theory has any practical applicability here."

Adsorption is an extremely minute amount of either increase in the concentration or decrease in the concentration of a solution which takes place at the surfaces where the solution comes in contact with another substance, such as the walls or bottom of a vessel or the air at the top surface, or a bubble in the solution, or a solid particle in the solution, either mineral or gangue. It is in this ore concentration art an altogether useless and negligible thing, although in the dyers' art it is a useful thing.

In the froth-flotation art it is an uncontradicted fact that there is no relation of cause and effect between adsorption and mineral-froth flotation. Although a number of soluble mineral-frothing agents cause positive adsorption (i. e., minute increase of concentration in any surface layer of the solution), this quality of causing positive adsorption

is equally true of such a substance as saponine (Higgins, R., Vol. I, p. 470, Q338) which is not a mineral-frothing agent and is named in the patent in suit as a soluble substance which is not a mineral-frothing agent (R., Vol. II, p. 664, spec. p. 1, line 49); and more conclusive still, common salt, sodium chloride, which with copper ores acts as a mineral-frothing agent in solution, causes negative adsorption (i. e., minute decrease in the concentration of the dissolved substance in the surface layers of the solution) (Higgins, R., Vol. I, p. 472, Q348; summing up pp. 470-472, Qs337, 347).

Adsorption takes place wholly in the solution. Its magnitude is microscopic, within the range only of molecular attraction, i.e., it is present in a surface layer of the solution only one molecule thick. If and when positive adsorption takes place in the part of a solution which is in contact with an absorptive substance, such as a fabric to be dyed, the concentrated solution is absorbed by the fabric and a direct benefit results. When positive or negative adsorption takes place in the part of a solution which is in contact with a non-absorptive substance, such as a particle of metalliferous mineral or a particle of gangue, nothing further happens. There is conclusive evidence of this in the undisputed facts above stated that of two substances one of which in solution causes positive adsorption (concentration) and the other of which in solution causes negative adsorption (dilution), both act as mineral-frothing agents in solution. There is further conclusive evidence of this in the undisputed fact that of the substances which in solution produce positive adsorption some do and at least one does not act as a mineral-frothing agent in solution. Therefore the minute and microscopic phenomena of adsorption are wholly negligible in mineral-froth flotation and the theories built thereon, being contradicted by the facts, must be discarded. Nevertheless the Circuit Court of Appeals in the instant case, accepts and approves the "adsorption theory presented in evidence through defendant's witness Taggart" (R., Vol. I, p. 650).

Of the testimony of defendant's witnesses setting forth this theory, we will first discuss that of Dr. Bacon, which covers the whole subject.

Dr. Bacon first gives an erroneous definition of adsorption as (R., Vol. I, p. 345, Q24) "the coming out of solution onto a solid surface and even onto a gas surface." He further says:

> "Wherever there is a surface, the concentration of the substance is always greater near that surface, and it may come out of solution at that surface, and when I say 'adsorption' in this connection, I mean the actual coming out of solution onto the surface to change the surface to a minute extent."

This erroneous definition he modifies in cross-examination to the extent of saying that the word "adsorption" includes both the concentration within the liquid at the surface of the liquid and the coming out of solution on to the opposed surface (R., Vol. I, p. 359, XQ86), and further admits (p. 360, XQ89) that a number of scientists use the word adsorption referring only to the concentration in the surface layer of the liquid, and therefore in the liquid (XQ90). Again he compares the adsorption which takes place in the dye industry (*i.e.*, the actual transfer of the dye material that was in solution in the dye liquor into the material of the fabric to be dyed by reason of the *absorptive* nature of the fabric), with the adsorption which he says takes place in froth-flotation concentration (p. 361, XQs91, 92), although he admits that the defendant's agent alpha-naphthylamine does not go into the copper, whereas the dye goes into the fabric (XQ93). He also admits that adsorption is a phenomenon in the range of molecular attraction (XQ95). His theory is therefore that when a solution comes in contact with another substance, whether it is a solid or air, whether it is mineral or gangue, there is not only a minute increase of concentration in the liquid at the contact surface but also a minute shooting of molecules either into the air or against the solid surface, and that this in froth flotation with mineral-frothing agents in solution, causes the solid particles (all of them) to be minutely coated with the mineral-frothing agent which, according to his theory, is precipitated out of the solution and on to the surfaces of the solid particles.

He was then asked about negative adsorption, which he had completely ignored, and the example of common salt was given

to him (R., Vol I, pp. 361, 362, XQs96, 97). Here he confessed his ignorance, but admitted that there is such a thing as negative adsorption (XQs98, 99) and contrasts it with positive adsorption, as follows (XQ100):

> "In negative adsorption you would have the opposite situation that instead of there being a concentration, there would be a lesser amount.
> XQ101. A dilution?
> A. A dilution, yes."

Of course with the opposite situation the minute molecules of the substance in solution would shrink away from the air bubble particles and if, as the fact is, mineral-froth flotation can be attained with a substance in solution which exhibits negative adsorption, e. g., common salt, then the entire theory that the coating of solid particles by minute molecules precipitated out of solution is the cause of or contributes to the mineral-froth flotation phenomena, must be abandoned.

Professor Taggart's testimony as to adsorption is very general and indefinite. He treats it as a concentration phenomenon, altogether overlooking the negative or dilution phenomenon (R., Vol. I, pp. 254, 255, Q149) and gives the illustration of the dyeing industry (Q150) where unquestionably adsorption helps absorption. He utterly fails to explain how a substance in solution which effects negative adsorption of the solution can produce mineral-froth flotation, and therefore he, as well as Dr. Bacon, stand upon a theory which is contradicted by the facts and therefore must be discarded.

The real purpose of this erroneous theory of precipitation of minute molecules out of solution and on to the surfaces of solid particles suspended in the solution, is the endeavor to establish the fact that there is no difference between a fixation on the mineral particles of undissolved oily material having a preferential affinity for metalliferous matter, such as undoubtedly occurs and had been known for years to occur when oil and water and ore are mixed together, and the wholly different phenomena that occur when there is a substance dissolved in the ore pulp; and the real object in seeking to establish this

theory is to argue therefrom that the mode of operation is substantially identical in froth-flotation processes whether undissolved frothing agents or dissolved frothing agents are used. And this is made further evident by the effort which failed to establish the fact that this alleged precipitation of solid particles acts preferentially on the mineral particles. Dr. Bacon's experiments above considered were adduced to prove this alleged preferential precipitation and fixation, and the figures so apologetically put forward by him of ten times as much X-cake on the mineral as on the gangue are supposed to show this preferential action. But Dr. Bacon's experiments utterly failed to show the preferential action which he hypothesized. He testifies that he washed the solid materials with water 37 times (R., Vol. I, p. 369, RDQ136), although he did not testify that he dried the materials before washing them. He describes these washings (R., Vol. I, pp. 363, 364, XQ109) and in his description says (p. 364:

> "That on passing successive portions of water through, *the X-cake comes off very much faster from the gangue material—the granite—than it does off the chalcopyrite* [the metalliferous mineral]. That is, you find in the early stages of the testing that the filtrate, that is, the water which has passed through the gangue material, contains more of the X-cake than the one which has passed through the chalcopyrite."

Obviously if the X-cake came off the gangue "very much faster" than from the metalliferous mineral in these 37 successive washings, the condition of the gangue and mineral as to the minute amounts of X-cake remaining with them at the conclusion of these washings showed absolutely nothing as to what that condition was when the froth was formed and separated. If at the beginning of the operation the same or a greater amount of X-cake had been adsorbed on the gangue than on the metalliferous mineral, as he denies, the results might well be expected to be such as he says he found them. In other words, these experiments do not show that this minute adsorption phenomenon acts preferentially, and are quite consistent with

the hypothesis that it acts in froth formation not preferentially and selectively but indifferently and equally in relation to both gangue and mineral, and is a phenomenon which is minute and practically infinitesimal and is altogether negligible in the process of froth-flotation ore concentration.

Error of the Circuit Court of Appeals for the First Circuit in its conclusion that oleic acid and the other oils and oily substances of patent No. 835,120 are really partly soluble in the water of the pulp and that the mineral-froth phenomenon of that patent is due to that partial solubility.

The Circuit Court of Appeals for the First Circuit in support of its conclusion of anticipation of the patent in suit by Patent No. 835,120 wandered into the field of speculation on its own account, although inexperienced and untrained in the art. It said (R., Vol. I, p. 651):

> "Furthermore, a study of the testimony in the case *and the reason of the thing* have convinced us that oleic acid (the agent specifically named in patent No. 835,120 and declared to be immiscible in the patent in suit) and all the mineral frothing agents that have been used in these processes, in the limited amount prescribed of a fraction of one per cent on the ore, are soluble to some extent because *you cannot get froth flotation unless there is present a constituent soluble to an extent sufficient to produce the requisite froth or scum,* and the fact that oleic acid, when so used, produces the requisite froth or scum."

This was the theory of defendant's experts and, as we shall point out, it was whittled down to an admission that oleic acid was as soluble as window glass. With an infinity of time and oceans of water it would probably be possible to dissolve out of our windows the window glass which protects us from the weather, but we are not dealing with operations that take place over geologic ages but with the daily operations of great mills where thousands of tons of material are rapidly flowing through under treatment. Therefore, any solubility such as would result

from flowing water over window glass may be wholly disregarded, and this, according to the evidence, is the degree of solubility of oleic acid. For all practical purposes, and especially as used in the process of patent No. 835,120, oleic acid is insoluble. As Professor Taggart said early in his testimony (R., Vol. I, p. 211, Q. 38):

> "glass certainly would not be considered soluble for the purposes of flotation."

Although the process of patent No. 835,120 is explicitly founded upon and is carefully limited to the use of oily substances that act by reason of insolubility in water, defendant contends and endeavors to prove that a small amount of the oleic acid disclosed in that patent dissolves in the amount of water normally used and under the conditions of agitation disclosed in that patent, the intent being to prove that those who used oleic acid used a substance a trace of which dissolved, although they did not know it. Professor Taggart testifies as to tests wherein he determined, he says, that with 1 part of oleic acid to 4000 parts of water, in one case 5.6% and in another case 8% of that 1 part of oleic acid dissolved. In his direct examination a chart alleged to show solubilities determined in these and other tests was put in evidence as Defendant's Exhibit 95 (R., Vol. II, p. 1099) and generally described (R., Vol. I, pp. 237-239, Qs103-108a). This followed an earlier statement in answer to the Court's question (R., Vol. I, p. 217) from which we quote as follows:

> "If you go down to 1 or 2 pounds per ton of ore, which is the usual proportion there, I have made actual quantitative determinations of the amount in which oleic acid dissolves, and found that it was quite a sensible amount. I have forgotten just the particular figures, but as I recollect, somewhere between 6 and 10 per cent., dissolved in those proportions."

In cross-examination this statement was repeated to him and he was asked the exact figures and he gave them as crude oleic acid 5.6% and pure oleic acid 8% (R., Vol. I, p. 288, XQ292)

of the two pounds of oleic acid per ton. The details of these tests were then elicited (pp. 288, 289, XQs293-300). He says that in each test an oily residue was obtained from the water and represented the material that went into solution in the water in the test, but he failed to identify this residue as oleic acid. His testimony on this point is significant (R., Vol. I, pp. 290, 291, XQ304):

> "XQ304. Now, how did you identify that residue as oleic acid?
>
> A. Purely by elimination. There could not possibly be anything else there but that which had come out of the oil that was put in, and the oil that was put in was material that is bought under that name in the market. Of course, we assumed by elimination, that was oleic acid. There was no chemical test made for the actual determination of this material, because whether it is oleic acid, chemically pure or not, was not of any particular importance in this particular connection."

Obviously this residue, amounting in his experiments to from about two to three one-hundredths of a gram (0.0196 to 0.028 grams), may have been merely impurities such as are present in most substances and should be eliminated and totally disregarded in determining the qualities of the substances.

Finally he was asked whether what he called the solution of the oleic acid was absolutely clear with no opalescence, and he answered (R., Vol. I, p. 292, XQ312):

> "there was the slightest suggestions of opalescence. It was apparently utterly impossible to filter out to perfectly clear mixture."

And again he repeats the statement (XQ313):

> "If you get it out there in the full sunlight and hold it against something dark, you would get a suggestion of opalescence."

These determinations therefore did not come up to his own standard. In answer to cross-questions he had testified (R., Vol. I, p. 230, Q81):

"By the Court:

Q81. How do you tell about the solubility where your element is not clear in the water?

A. Ordinarily if there is not solution, the water will be clouded. The light in passing through is bent more or less as it passes from the water into the other substance and then bent as it comes out, and you get a cloudy effect instead of a clear effect."

Prior to that he had testified (R., Vol. I, p. 212, Q40)

"the proper thing to do is to take the every-day commonsense understanding of the word 'solution,' namely, the production of a mixture that looks just like water, or at least is clear."

Mr. Higgins gives practically the same standard in different language, using the word "brilliant" instead of "clear," and says that the solution must be "perfectly transparent" (R., Vol. I, pp. 486, 487, XQ432).

No argument can explain away the fact that in these tests in which Professor Taggart was dealing with minute amounts he did not get a clear or brilliant solution, and therefore he got a body of water which contained undissolved oleic acid.

And since, as above noted, he did not even determine whether the residue which he extracted from what he called his solution was oleic acid or was composed of impurities, he utterly failed to determine that any minute or measurable proportion of oleic acid was soluble under froth-flotation conditions.

As to the other tests shown in the chart Professor Taggart admits that in none of them did he determine the character of the residue obtained from what he called his solutions (R., Vol. I, p. 294, XQ329) and that the so-called solutions were not determined to be clear and free from opalescence in strong sunlight (XQs330, 331). This being so, the chart and its determinations may be dismissed from further consideration, except that it is well to note that his determination that 4% of the impure X-cake used by defendant in its mill would not dissolve cannot, of course, be accepted as modifying the admission that alpha-naphthylamine is soluble to an extent far in excess of the proportion actually used by the defendant (*infra*, p. 129), and

also that his determination in the ratio of 1 part of alpha-naphthylamine to 4000 parts of water was very far from the actual conditions in defendant's mill wherein less than half a pound of alpha-naphthylamine was dissolved in 10,000 pounds of water so that the actual ratio was not greater than 1 to 20,000.

The subject of tests of solubility is further illuminated by the testimony of Dr. Bacon. He testified generally that all successful flotation agents, and by this he meant mineral-frothing agents, "were partly or wholly soluble in water, in the proportions used" (R., Vol. I, p. 342, Q12). This, of course, included oleic acid. In cross-examination his attention was called to that statement, and he said that it was based upon "a large number of experiments which we had made which demonstrated that fact" (R., Vol. I, p. 353, XQ62).

He was then asked if he had demonstrated that fact in relation to oleic acid (XQ63) and at great length and evidently from not too accurate memory, he describes a number of experiments (R., Vol. I, pp. 353-355, XQs64-66). He was then asked for quantitative determinations (p. 355, XQ67) and in his long answers failed to give any quantitative determinations. This was called to his attention by the Court and Dr. Bacon admitted that he had not made any quantitative determinations (R., Vol. I, p. 357, XQ69), and it may be noted here that later, in his recross-examination, he reiterated that he expressed no opinion as to the quantity of oleic acid that was dissolved in his experiments (p. 371, RXQ144). In his cross-examination the Court asked him if glass dissolved to some extent (p. 357, XQ71) and he answered that it did, and then followed an answer to a further question by the Court from which we quote as follows:

> "By the Court:
> XQ72. You would not call glass soluble in water?
> A. I think you would in the sense that we are talking of here, for the reason that the quantities of substances that we are talking about that are used in flotation are so extremely small."

Thus we find that Professor Bacon in the sense in which he has been testifying, to wit, as to the order of magnitude in

which oleic acid is soluble, regards glass as soluble in water. This contradicts Professor Taggart's testimony. Professor Taggart had selected the minute and almost infinitesimal solubility of glass as an extreme example and had disclaimed that standard in his testimony as to the solubility of mineral-frothing agents, testifying as follows (R., Vol. I, p. 211, Q38):

> "For instance, the chemists in making their refined measurements considered glass soluble. Now, we do not ordinarily think of glass as soluble, and *glass certainly would not be considered soluble for the purposes of flotation.*"

Again, he protested against being led to the point of such solubility as was comparable with the solubility of glass as follows (R., Vol. I, p. 218, Q55):

> "The reason that I hesitated there was that I thought that your question had said that all of them were completely soluble in some proportions. That is, that if you have used a small enough amount of it with respect to the water, that in every case it would all go into solution. That is not the case *unless the definition of solubility is strained considerably, that is, to the point where, for instance, we say that glass is soluble.* If we went to that point, then that latter statement might be true, but *that I do not think, is a proper length to go.*"

Again, returning to Dr. Bacon, we find that the Court continued to interrogate him as follows (R., Vol. I, p. 358, XQ73):

> "XQ73. Well, then, under your interpretation of the word 'soluble,' glass is soluble.
> A. Yes, sir.
> XQ74. Would anything be not soluble?
> A. The trouble is that measurements have not been made. Now, I really think that if you go far enough, everything does have a slight solubility in water."

Dr. Bacon fittingly closed this subject in redirect examination as follows (R., Vol. I, p. 370, RDQs141, 142, 143):

> "RDQ141. What I am trying to get at, Dr. Bacon, is whether the oleic acid added to the water there was

in the proportions of flotation as they have been discussed here?

A. You mean the oleic acid added originally to the water?

RDQ142. Yes.

A. Yes.

RDQ143. Do you know whether glass, *if added to water in that proportion,* would show any discoverable solution of glass in the water?

A. *Absolutely.* When I say 'glass,' you will understand there is a great difference in the solubility of different glasses. There are some glasses which are quite soluble. In fact, *the ordinary glass that is used for window panes is fairly soluble.* Then, they make other types of glass, like the glass that is used for chemical glassware, that is quite insoluble, but *the ordinary type of soda lime glass that is used for some purposes is fairly soluble in water and is of the same order of magnitude as the oleic acid that we are talking about."*

That is certainly straining the definition of solubility beyond what "is a proper length to go." Nevertheless the Circuit Court of Appeals for the First Circuit, accepting Taggart's *ipse dixit* that you cannot get froth flotation unless there is a soluble constituent present, profess to find in January, 1929, a new explanation of the mineral-froth phenomenon of the oleic acid process of patent No. 835,120, which phenomenon is attributed in the patent to the preferential coating of the mineral particles by the oleic acid—an explanation of the phenomenon which this Court and the English House of Lords have also accepted. The Circuit Court of Appeals for the First Circuit now discovers that the froth-flotation phenomenon of the oleic acid process was due to the dissolving of a part of the oleic acid in the water of the pulp.

Error of the Circuit Court of Appeals for the First Circuit in its understanding and use of the phrase "Preferential affinity for metalliferous matter over gangue."

This descriptive language, used in patent No. 835,120, and quoted and repeatedly used in the decisions of this Court in

Minerals Separation v. *Hyde* and *Minerals Separation* v. *Butte & Superior Mining Company*, as above referred to, unquestionably means that quality of a substance which causes it, when in undissolved condition in the water of an ore pulp, to coat the metalliferous mineral particles suspended in the pulp in preference to the gangue particles suspended in the pulp as in consequence of the agitation it comes in contact alike with the mineral and gangue particles in the pulp. To exercise this preferential affinity the substance must remain undissolved. It is the old and well-known characteristic of oily substances brought in undissolved condition in contact with metalliferous mineral and rock or gangue immersed in water. The oil has a strong affinity for the metalliferous material and the water has a strong affinity for the rock or gangue, so that the oil, which is repelled by the water, coats the metalliferous material in preference to the gangue, and the water wets the gangue in preference to wetting the metalliferous mineral.

What was said by this Court has been fully considered above.

The British litigations involving flotation processes dealt with the Elmore patents wherein this preferential affinity was described as "the selective action of oil" (*British Ore Concentration Syndicate, Limited* v. *Minerals Separation, Limited*, 27 R. P. C. 33), but Lord Atkinson, in interpreting the disclosures of Elmore patent No. 6519 of 1901 spoke of "a mixture of powdered ore, oil and water" wherein the oil had "in accordance with some obscure chemical law or *affinity*, seized upon the metallic portions of the ore in *preference* to the earthy particles" (*British Ore Concentration Syndicate, Ltd.* v. *Minerals Separation, Ltd.*, 27 R. P. C. at 49), thereby in effect defining preferential affinity.

The term "the selective action of oil" appears in the Cattermole British patent 26,295 of 1902 (R., Vol. II, p. 902, lines 5, 6; p. 903, lines 31, 32) which in the process produces "oil-coated metallic mineral particles" (p. 902, line 22). It also appears in Cattermole U. S. patent 763,260 associated with a statement of the preference, as follows (R. Vol. II, p. 970, lines 20-28) ::

> "when a mixture of powdered metalliferous matter and gangue is treated with oil suspended in water * * * the oil has a more or less selective action and will coat

> the particles of metalliferous matter in preference to the particles of gangue, while the particles of gangue will be wetted by the water."

This language is exactly repeated in Cattermole patent 777,273 (R., Vol. II, p. 974, lines 17-24). Cattermole, Sulman and Picard patent 777,274 speaks of "the superior physical attraction exerted by minerals for fatty or resin acids" (R. Vol. II, p. 982, lines 13-15), with the result in the process that "the mineral particles become attached to or more or less coated by films of fatty or resin acid" (p. 982, lines 54-56). Thus in this art the quality of "preferential affinity" or "superior physical attraction" of oils undissolved in water for metalliferous mineral particles as contrasted with their lack of affinity for gangue particles, resulting in "selective action of the oil" in coating the mineral particles in preference to the gangue particles, was old and well known. The term "preferential affinity" as used in patent 835,120 has a clear, precise and definite meaning and depends upon the presence of an undissolved oil in the water of an ore pulp. It had that meaning in bulk-oil or oil-buoyancy flotation processes, and it had that meaning in metal-sinking processes. Its use in patent 835,120, as recognized by this Court in its prior decisions, necessarily implied oil undissolved in water. The whole art prior to the patent in suit wherein oil was used, utilized only oil which remained undissolved in the water of the ore pulp, and utilized it to coat the metalliferous mineral particles in preference to the gangue particles. With what might happen from the dissolving of any soluble constituents of the oil, if they happened to be present, the prior art was not concerned and had no knowledge whatsoever.

In their opinion in discussing patent No. 835,120 the Circuit Court of Appeals for the First Circuit first quote the paragraph of its specification containing the limitation to "substances which have a preferential affinity for metalliferous matter over gangue" (R., Vol. I, p. 645).

In the next paragraph that statement is repeated in a proper statement of the discovery on which the process of that patent is based.

In the next paragraph occurs the following statement:

> "The specification of that patent does not differentiate between the oils, fatty acids or other substances having a preferential affinity for metalliferous matter in the sense that they are soluble or insoluble, or in part soluble and in part insoluble, and the terms miscible and immiscible, soluble or insoluble, are nowhere mentioned in the specification or claims of the patent. The specification and claims, however, speak of the mineral particles being 'oil-coated' or as having been brought into 'efficient contact with' the oil or agent used."

It will be noted that this statement overlooks the fact that preferential affinity for metalliferous matter in an ore pulp can only be exerted by a substance which remains undissolved in that ore pulp. The "oil-coated" condition of the metalliferous mineral particles and the "efficient contact" of the metalliferous mineral particles and oil or agent used can only result from the presence in the ore pulp of an undissolved oil or agent. The opinion then says (R., Vol. I, pp. 645, 646):

> "On account of this the plaintiffs contend that the frothing agents disclosed in that patent (No. 835,120) are immiscible; and that only immiscible agents will coat or be brought into efficient contact with the mineral particles. While some of them are undoubtedly substantially insoluble or immiscible, others are substantially soluble, or partly immiscible and partly soluble; and the disclosure of the patent by the use of the terms 'oils, fatty acids, or other substances having a preferential affinity for metalliferous matter over gangue,' does not differentiate between them as frothing agents or point out any which, if used in the limited amount of the patent [a fraction of one per cent on the ore] will not coat the mineral particles. On the contrary the specification and claims clearly give one undertaking to practice the process of the patent to understand that any or all of them will coat the mineral particles."

This statement is highly confused. While it is true that this Court held that the term "oils, fatty acids, or other substances

having a preferential affinity for metalliferous matter over gangue" does not differentiate between them as to their quality or degree as frothing agents, it clearly held that it did require the presence in the ore pulp of undissolved substances and considered only the operation of such undissolved substances. The last sentence of the above quotation is accurate. The error of the Circuit Court of Appeals, persisting throughout its opinion, is the failure to comprehend that to exercise preferential affinity in an ore pulp the substance must remain undissolved in the ore pulp.

The conclusion of the consideration by the Circuit Court of Appeals of the prior decisions of this Court in the *Hyde* case and the *Butte* case is that this Court found as to the oily liquid or oily substance (R., Vol. I, p. 647):

> "that the only limitation was that it should have a preferential affinity for metalliferous matter."

This is not quite accurate since there was also the limitation expressed in those decisions, as a necessary consequence of that preferential affinity, that it should coat the metalliferous mineral matter in the ore pulp, but aside from that if this had been the only limitation, it would have been sufficient to exclude from the operation of the process of patent No. 835,120 any substances that dissolved in the ore pulp. The term "preferential affinity" was wholly misunderstood by the Circuit Court of Appeals. They conceded that this Court had held it to be a limitation clearly imposed but they failed to understand that it of necessity required the presence of a substance that remained undissolved in the ore pulp and preferentially coated the metalliferous mineral particles.

Errors of the Circuit Court of Appeals for the First Circuit in the instant case in misquoting and misunderstanding the opinion of this Court in the Butte & Superior case.

The last paragraph on page 647, continuing on page 648 (Vol. II) of the opinion of the Circuit Court of Appeals contains confused and erroneous quotations from the opinion of

this Court in the *Butte & Superior* case, with unjustified bracketed insertions indicating a complete misconception of the meaning of the language of this Court. This Court was only considering there whether or not the petroleum products, kerosene oil and fuel oil, both insoluble substances, were oils of patent No. 835,120. This Court said (250 U. S. 348) "the question we are discussing relates only to the use of petroleum products." Their quality as frothing agents was under consideration. Plaintiffs had contended that they were not frothing agents. This Court held that they were frothing agents of the patent 835,120 —whether more efficient or less efficient was unimportant, since they were oils which unquestionably had a preferential affinity for metalliferous matter over gangue, and therefore were within the broad description of the specification. The Circuit Court of Appeals, failing to comprehend the actual question that was being considered by this Court, by misquotations and by unwarranted interpolations, put forward its interpretation as though this Court had been considering whether or not these petroleum products were insolube (immiscible) or soluble (miscible). That question was not under consideration. The agents being considered, kerosene oil and fuel oil, are wholly insoluble and immiscible substances. Nobody denied that. No question of solubility entered into the subject matter this Court was considering. Yet, the Circuit Court of Appeals appears to have considered that question as the only question under consideration, and in fact it treated the decision of this Court as determinative of that question, although that question was not in any way involved in what this Court said or decided.

We will now correctly quote from the opinion of this Court in the *Butte & Superior* case, the paragraph above referred to (250 U. S. at 349, 350):

> "It is argued that the provision of the claims that the mixture prescribed, of oil, water, and ore, shall be agitated until the oil-coated mineral matter forms into a froth, serves to differentiate the 'frothing oils' from others having the required preferential affinity for metalliferous matter, but which, when agitated in the mixtures, may not produce the characteristic froth, if any such there are, and that a proper construction of the

> patent limits it to such 'frothing oils,' and renders the use of them in a fraction of 1 per cent on the ore an infringement when used with 'non-frothing oils' having the required affinity in amounts sufficient to make the combination exceed the quantity limit of the patent."

In the opinion of the Circuit Court of Appeals for the First Circuit (Vol. I, p. 647, last paragraph, continued on p. 648) this paragraph was broken up into two quotations and from the second of these quotations essential words were omitted and to it unjustified interpolations were added. At page 647, line 7 from the bottom, the words "for metalliferous matter" after "affinity" were omitted. In line 5 from the bottom the words "if any such there are" following the word "froth," were omitted from the quoted part and inserted in an interpolation, but were preceded there by the word "immiscible," so that the bracketed part reads "[immiscible, if such there are]." The same unjustified interpolation was repeated on the bottom line of page 951 and top line of page 952, to wit "[immiscible, if such there are]."

The oils referred to in the above quotation as "having the required preferential affinity for metalliferous matter" but which, when agitated in the mixture, may not produce the characteristic froth, were the insoluble petroleum products, kerosene oil and fuel oil. By erroneous quotation and interpolations this was changed to indicate a doubt expressed by this Court as to the immiscibility of these petroleum oils. No such doubt was expressed by this Court, yet the belief of the Circuit Court of Appeals that such a doubt was expressed dominated its entire opinion.

Following these misquotations with unjustified interpolations, the Circuit Court of Appeals correctly quotes the following conclusion stated by this Court, and then, having erroneously stated the premise to that conclusion, erroneously interprets that conclusion, as follows (R., Vol. I, p. 648):

> "This holding is a complete refutation of the statement in the patent in suit (No. 962,678) where it says that the frothing agents of the prior art are only such as are immiscible in water, to wit:

'In the frothing processes hitherto known the substances used to secure the formation of a mineral-bearing froth has been oil or an oily liquid immiscible with water.'

"It is not only a refutation of this statement of the patent in suit but an affirmation of the proposition that 'oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue,' whether immiscible or soluble, or partly immiscible and partly soluble, are frothing agents within the meaning of the disclosure of patent No. 835,120, which is a disclosure of the art prior to the patent in suit."

Obviously this holding was in no way related to the quoted statement of the patent here in suit, in no way refuted it, and in no way affirmed the proposition that soluble mineral-frothing agents are within the ambit of the disclosure of patent No. 835,120. This holding was briefly that the insoluble petroleum products, kerosene oil and fuel oil, were oils within the scope of the claims of patent No. 835,120 and should be counted as such in determining whether the total amount of oil used was greater than a fraction of one per cent. Obviously it assumed that the process disclosed in patent No. 835,120 required the presence in the pulp of an undissolved oily agent which, exercising a preferential affinity for metalliferous matter over gangue, preferentially and selectively coated the metalliferous mineral particles.

This should eliminate patent No. 835,120 as an anticipation of the patent here in suit.

Other errors of the Circuit Court of Appeals in the instant case in interpreting and construing the disclosure of patent No. 835,120.

The principal error in this particular occurs through the mixing up of the subject-matter of the patents prior to patent No. 835,120 with the subject-matter of that patent. By erroneous additions to the disclosures of patent No. 835,120, associated with erroneous interpretations of the actual disclosures of that

patent, that patent is metamorphosed into an anticipation of the process of the patent in suit—into a disclosure of the identical invention of the patent in suit.

The first of these prior patents is the principal Cattermole metal-sinking process patent No. 777,273.

The second of these prior patents is the Cattermole, Sulman & Picard soap and granulation patent No. 777,274, disclosing a useful adjunct to that metal-sinking process.

Finally, the New Zealand patent which, as originally taken out, included both the invention of patent No. 835,120 and the invention of patent No. 777,274, is cited by the Circuit Court of Appeals as the final confirmation in patents prior to the patent in suit of the fact that patent No. 835,120 discloses the identical invention of the patent in suit.

The New Zealand patent and patent No. 835,120 were held by the Circuit Court of Appeals to disclose that there was no difference between the action of undissolved and dissolved mineral-frothing agents. The statement is as follows (R., p. 650):

> "Then again, the disclosure of these two prior art patents,—that agents having a preferential affinity for metalliferous matter coat the mineral particles with a slight film,—is supported by the adsorption theory presented in evidence through defendant's witness Taggart, that such agents, though in solution, will attach themselves to and slightly coat the mineral particles."

What is here meant by "agents having a preferential affinity for metalliferous matter," is dissolved agents that do not and cannot have or exert that preferential affinity, as we have shown above in argument as to the misunderstanding by the Circuit Court of Appeals in the instant case of the phrase "preferential affinity." This appears from the context and from the latter part of the quotation.

We will now consider the several patents that were regarded by the Circuit Court of Appeals as having a bearing on its understanding of the disclosure of 835,120 and confirming same.

CATTERMOLE PATENTS.

These patents are for the metal-sinking process described by this Court in *Minerals Separation, Ltd.* v. *Hyde,* 242 U. S. 261 at 265. The minimum amount of oil used in these processes was 1.8% on the ore, or 36 pounds per ton of ore (Higgins, R., Vol. I, p. 508, XQs563, 564). The function of the oil was to coat the metalliferous mineral with a sufficiently adhesive coating to cause the metalliferous mineral particles, under the contacts brought about by the agitation, to adhere together and form granules which were separated by sinking to the bottom, against an up-current of water.

Patent No. 763,260 of June 21, 1904, Defendant's Exhibit 34 (R., Vol. II, pp. 969-972). The metal-sinking process here disclosed is characterized by the use of an alkaline pulp. It also includes, as do the other Cattermole patents, the use of an emulsifying agent for the purpose of assisting the agitation in breaking up the oil into small globules to be disseminated through the pulp.

This patent is referred to by Professor Taggart as disclosing the use of certain wood or coal tar products (R., Vol. I, p. 189). Obviously the use of these products in this process where the recovery of concentrates was by sinking would not in any manner have informed the art of any possible use of these wood or coal tar products in processes where the recovery of concentrates was by flotation. Flotation of any part of the metalliferous mineral in this metal-sinking process would result in that mineral going to waste with the gangue.

Professor Taggart also quotes from this patent a description of the emulsifying agents, which obviously only perform the function of helping to disseminate thick and insoluble oils through the pulp so that they more readily and uniformly coat the metalliferous mineral particles and cause the particles to adhere together into granules and sink.

Patent No. 777,273, of December 13, 1904, Defendant's Exhibit 35 (R., Vol. II, pp. 973-977). The principal difference between the disclosure of this patent and that of patent No.

763,260, just described, is that an acidified pulp is used in place of the alkaline pulp of that patent. Otherwise its disclosures are substantially the same as in the patent just considered. As this was the principal patent for the Cattermole metal-sinking process, it was referred to in the specification of patent No. 835,120, as this Court says (*Mineral Separation, Ltd.* v. *Butte & Superior*, 250 U. S. 346):

> "to describe the advance which the patentees claimed to have made from the prior art Cattermole agglomeration of metalliferous matter into granules, which separate from the gangue, and sink to the bottom of the pulp under treatment, to the discovery of the patent in suit, with its metal-bearing froth, rising to the surface of the pulp."

Error of the Circuit Court of Appeals for the First Circuit as to this Cattermole Patent.

The Circuit Court of Appeals in the instant case erroneously held that the purpose and effect of the reference to this patent No. 777,273 in patent No. 835,120, was to import into the disclosure of patent No. 835,120 for a froth-flotation process, all of the substances as agents that were disclosed in this Cattermole patent for a metal-sinking process. They said (R., Vol. I, p. 648):

> "Among the oils, fatty acids and other substances having the preferential affinity referred to in patent No. 835,120, are the tar products of the Cattermole prior art patent No. 777,273,"

Of course it does not follow at all that when a patent refers to a prior patent it includes all of the disclosures of that prior patent as a part of its own disclosure, and particularly, as in the present instance, where the reference made is merely to contrast the quantity of "oil" (835,120, p. 1, line 18) or "oleic acid" (p. 1, line 26) and "intended to describe the advance which the patentees claimed to have made from the prior art" as this

Court said in the *Butte* case (250 U. S. at 346). In the Cattermole process everything that floated was wasted. Everything that went into solution was lost and worse than useless. It did not follow at all that everything that was useful in the Cattermole metal-sinking process would be useful in the froth-flotation process. The discovery of the froth-flotation process was made as matter of historical fact by reducing the amount of *oleic acid* in the Cattermole process. The result was a complete reversal of the process and the investigators recognized it as a great discovery and invention. Today, with the knowledge which patent No. 835,120 and the patent in suit both gave to the world, it has been found that certain tar products, which are complex mixtures of substances, may be made to contain substantial quantities of phenols and cresols, so that in their use in froth-flotation ore concentration, the process of patent No. 835,120 and the process of the patent here in suit can be conjointly used with advantage. But this is all after-acquired knowledge—it followed the discovery and invention of the two froth-flotation processes. No one ever used these tar products in carrying on the Cattermole process. No one used these tar products in carrying on the process of patent No. 835,120, no one used these tar products for jointly carrying on the process of patent No. 835,120 and the process of the patent in suit, until long after the discovery and invention of the process in suit.

British patent 26,295 of 1902, Defendant's Exhibit 32 (R., Vol. II, pp. 962-964). This is the first patent for the Cattermole metal-sinking process and is sufficiently described by Professor Taggart (R., Vol. I, p. 188). Apparently defendant refers to it because it mentions a number of oils useful in the Cattermole metal-sinking process and a number of emulsifying agents also useful in that process. Obviously this has nothing to do with mineral-bearing froths.

Patent No. 763,259 of June 21, 1904, Defendant's Exhibit 33 (R., Vol. II, pp. 965-968). This patent is for a supplement to the Cattermole metal-sinking process, a process of breaking down the granules so as to separate out metalliferous minerals therein, as, for example, separating zinc sulphide from lead

sulphide. It does not disclose an ore-concentrating process. Here emulsifying agents are used to remove the oil coatings from the metalliferous mineral particles in the granules of concentrates with which the process starts.

CATTERMOLE, SULMAN AND PICARD PATENTS.

These patents disclose a process of concentrating ores by the employment of a *soluble substance* which, after it has been dissolved and disseminated in the ore pulp, is chemically decomposed therein by the action of an acid so as to form an insoluble substance, which, as it is formed, is precipitated out of solution and coats the metalliferous mineral particles with which it contacts with a sticky or greasy coating, either for the purpose of the Cattermole metal-sinking process, i.e., causing the particles to adhere together upon agitation to form granules which sink, or for the purpose of causing the greased mineral particles to adhere to a greased belt or to greased wood, sawdust or other suitable material lighter than water, or to adhere to gas bubbles to be lifted thereby to the surface to float as a skin float. The process also included the recovery of the insoluble substance from the metalliferous mineral particles, by chemically decomposing it so that it again became a soluble substance. This process was known as the *soap process*. This is the whole of the disclosure of these patents, embodied in two United States patents, included in one British patent and included with the process of patent No. 835,120 in one New Zealand patent. Since the British patent covers the whole subject, it will be first considered.

British patent No. 17,109 of 1903, Defendant's Exhibit 36 (R., Vol. II, pp. 978-981). The part of this specification which the defendant relies upon is included in the following paragraph (p. 979, line 50, p. 980, line 10):

> "In carrying out our invention, the suitably crushed ore is suspended in water, and to the mixture an addition of a small quantity of soap solution is made. A small amount of mineral acid is then added which decomposes the soluble soap or other similar compound

by uniting with the alkaline base thereof, thus liberating in a state of chemical sub-division the fatty or resin acid or other compound such as cresol, etc., in intimate contact with the suspended ore particles. It is found that the liberated acids, etc., which may even be solid under ordinary conditions, are precipitated and adhere to the sulphureted minerals, or to sulphur, graphite, or free metals present in the ore, leaving the gangue or earthy particles preferentially wetted by water, and free from adhesions of fatty acid and the like."

The term "cresol, etc." includes, according to the context, phenol or cresol, and the term "fatty or resin acid" includes oleic acid. Oleic acid is normally a liquid and is wholly insoluble. Phenol is normally a solid and is soluble to a limited extent. Six pounds will dissolve in 100 pounds of water (Bacon, R., Vol. I, p. 347, Q32). Cresol is normally a liquid, and its solubility is one-half that of phenol (Higgins, R., Vol. I, p. 507, XQ557), that is to say, 3 pounds of cresol will dissolve in 100 pounds of water.

The process is dependent upon the coating of the metalliferous minerals with oleic acid or phenol or cresol. All of the oleic acid would be precipitated out and would coat the metalliferous minerals. Only so much of the phenol or cresol as would not dissolve would be precipitated out and would coat the metalliferous mineral (Higgins, R., Vol. I, p. 507, XQs555, 556). The process was far beyond the range of practicability had any attempt ever been made to use it with phenol or cresol. With a 2 to 1 pulp 240 pounds of phenol or 120 pounds of cresol would be dissolved and useless and lost (XQ555). As Mr. Higgins said (pp. 507, 508, XQ561):

> "I am quite sure that it would be more expensive than the process could possibly stand."

Since the process was essentially a granulation process, a normal amount of oleic acid would have been 36 pounds per ton of ore (XQs563, 564). But even as to this the cost was too great and the process was too expensive for use on a large scale (XQ565).

Turning to a consideration of the exact language of this patent above quoted, an effort is made by Professor Taggart to misinterpret the words "chemical sub-division." Professor Taggart interprets this as (R., Vol. I, p. 193, Q6) "in solution in water." What the language means is that the substance is first formed in the finest possible state of division, to wit, as molecules, as the result of a chemical decomposition which is a chemical sub-division of the original molecules and the formation of new molecules. These molecules speedily unite in masses, and if they are not dissolved, they coat the metalliferous mineral particles. Molecules that dissolve are useless in the process. This is well explained by Mr. Higgins (R., Vol. I, pp. 440, 441, Qs136-142). In the case of oleic acid Mr. Higgins describes what takes place: first the formation of a very fine emulsion, and then if given time at rest, the floating to the surface of the little globules of oil (R., Vol. I, pp. 441, 442, Qs143-151).

Professor Taggart in this connection refers to a statement in the so-called Treatise wherein Mr. Sulman describes this invention and says (Deft.'s Ex. 85, R., Vol. I, pp. 192, 193):

> "But by employing the oil in the shape of a soap solution, which may thus be of any desired dilution, and adding this to the acidified pulp, the oil is at once precipitated throughout the pulp mass in a condition of almost molecular fineness, and permits practical uniformity of the oil-coating."

Here Mr. Sulman says that it is precipitated in "almost molecular fineness." As a matter of fact new molecules are formed by chemical sub-division and those that do not dissolve are precipitated throughout the pulp mass. Precipitation is the antithesis of solution.

When this invention was made Mr. Sulman did not know that it was possible to disseminate a much smaller amount of oleic acid than he had ever then dreamed of, to wit, two pounds of oil to the ton of ore, by mere agitation so as to uniformly coat the metalliferous mineral particles. That was not discovered until the process of patent No. 835,120 was invented.

Patent No. 777,274 of December 13, 1904, Defendant's Exhibit 37 (R., Vol. II, pp. 982, 983). This patent is closely limited to the utilization of the soap phenomena in the Cattermole granulation and metal-sinking process. It repeats the disclosure of the British patent as to the soap phenomena and metal-sinking, and those disclosures and the testimony relating to them have been fully considered above. It is specifically referred to in the patent in suit, and the numerous errors in the opinion of the Circuit Court of Appeals in the instant case as to this part of the disclosure of the patent in suit will be considered later (*infra*, p. 99).

It was also referred to in the specification of patent No. 835,120, and here the two references to this patent were carefully confined to the disclosure of oleic acid therein and formed the basis of a description in that patent of the method of producing oleic acid in the pulp by introducing soluble oleic soap and then decomposing the oleic soap with a mineral acid, thereby forming and precipitating insoluble oleic acid so that it would coat the metalliferous mineral particles. It is suggested in patent 835,120 that after the process has been carried on and the oil-covered concentrate recovered, the concentrate may be treated with an alkali to saponify the oleic acid coating the mineral particles, thus again forming soluble oleic soap which may be washed off the particles and again used in a repetition of the froth-flotation process.

As noted above in this process anything that dissolved was useless and anything that floated went to waste with the gangue, since the metalliferous mineral was recovered by sinking the granules formed in the process against an upcurrent strong enough to carry over the gangue or rock particles in suspension in an overflow at the top of the apparatus from which the metalliferous mineral granules were separated at the bottom. If this process had ever been carried on with phenol or cresol (which the evidence indicates was never done and the evidence shows would have been prohibitively expensive) it would have been necessary, first, to provide a sufficient quantity of a phenylate (the alkaline salt of phenol) or a cresylate (the alkaline salt of cresol) to produce, when phenol or cresol were

formed by the decomposition of these alkaline salts, sufficient phenol or cresol to saturate the entire solution (pulp water) and, secondly, above that, to provide sufficient additional phenol or cresol to exercise, when formed and precipitated, a preferential affinity for, and to form a sticky or adhesive coating on, the metalliferous mineral particles. The presence of phenol or cresol in this saturated solution could not, under the conditions of this process, have resulted in the production of a metalliferous-mineral-bearing froth, for the reason that the metalliferous mineral, with its sticky and adhesive coating, would be incapable of attachment to air bubbles and would instead form granules that would sink, and even if any modicum of metalliferous-mineral-bearing froth were formed it would go over at the top to waste with the gangue.

Patent No. 788,247, of April 25, 1905, Defendant's Exhibit 38 (R., Vol. II, pp. 984, 985). This patent discloses the remainder of the disclosure of the British patent. In the absence of any disclosure in this patent of the amount of oil to be used, and in view of its cross-reference to patent No. 777,274 (p. 984, lines 19-23) the only disclosure is of the proportions of oil of the granulation process.

This patent follows a description of the soap phenomena with a general description of all methods of attempted flotation of minerals which were known prior to the invention of the process of patent No. 835,120. First, it describes the Froment method of gas generation by decomposition of carbonic acid (Spec. p. 1, lines 58-75) and then it says (lines 75-84):

> "or the mineral particles may be caused to adhere to metallic or other suitable surfaces coated with similar fatty acids, or, finally, the coated mineral particles may be caused to adhere to wood, sawdust, or other suitable material lighter than water coated with similar fatty acids, &c., which can then be removed by flotation, in each case leaving the mineral-free gangue particles capable of rejection."

This includes the greased belt method and flotation by adherence to wood, sawdust, or other suitable material which has been oil-coated.

The patent does not from beginning to end describe any agitation—indeed the purpose of the invention was to replace the agitation for mixing the oily substance and ore by the diffusion and dissolving of a soluble substance, and then chemically precipitating an insoluble derivative of that substance in a state of fine subdivision to preferentially coat the metalliferous mineral particles. No agitation was required other than a gentle stirring of the pulp to make the solution uniform.

It may be noted at this point that Mr. Higgins testifies to the fact that the soap process of this group of patents has not proved of any practical value (R., Vol. I, p. 442, Q153).

New Zealand Patent No. 19,633.

This patent, of October 27, 1905, is Defendant's Exhibit 55 (specification and drawings as originally issued, R., Vol. II, pp. 1011-1023; amended specification allowed December 11, 1912, pp. 1024-1030). This patent as issued October 27, 1905, included both the froth-flotation process with the minute amount of oil of United States patent No. 835,120 (designated in the marginal note, p. 1011, as "Oleic acid froth") and the soap process of British patent No. 17,109 of 1903 and the other patents just above discussed (designated in the same marginal note, p. 1011, as "Soap"). With the patent as amended on December 11, 1912, we are not concerned. It may be noted, however, that the specification was amended by the elimination of all description of and claims for the soap invention. The soap invention having proved of no practical utility, the patentees in 1912 eliminated it from this patent.

The oleic acid froth process part of this patent specification (R., Vol. II, pp. 1011-1014, pp. 1019, 1020, claims 1-4, p. 1021) adds nothing to the disclosure of patent No. 835,120. The soap process part of this specification (R., Vol. II, pp. 1015-1018, claims 5-9, p. 1022) adds nothing of substance to the disclosures just above considered, but it is of interest that the limits of the proportions of *fatty acid* to be used in this soap process are here stated. The statement is as follows (p. 1016):

> "For example, if the proportion of fatty acid produced in the mixture be about 1% to 4% of the ore and if the mixture be thoroughly agitated, the coated metalliferous particles will adhere together and form granules or small agglomerate masses which, partly by reason of gravity and partly on account of their bulk, as compared with the individual grains of gangue, may be readily separated in up-currents or by other suitable classification apparatus."

And there is the further statement (*ib.*)

> "If however, the proportion of fatty acid be less than 1% of the ore a greater or less proportion of the coated metalliferous matter will form into a froth as described at the beginning of this specification."

i.e., the limits of the soap process are from 4% (80 pounds per ton of ore) down to 1% (20 pounds per ton of ore) of fatty acid and if the proportion of fatty acid be less than 1% the process will be changed to a froth-flotation process. The only fatty acid specified is oleic acid. After the making of the soap invention it was discovered that if the proportion of oleic acid be reduced to less than one percent granulation will be changed to froth flotation. This statement is in exact accordance with the findings of this Court in the *Hyde* case.

The limits in oil proportions of the soap process are, as we have above noted, not specifically set out in the other soap patents, but in this specification, wherein the soap process is juxtaposed with the oleic acid froth process, the patentee was careful to set out these limits in order to clearly differentiate from the froth process.

It is to be remembered that the soap phenomena are described in patent No. 835,120 as capable of application to and use as an accessory of that process when oleic acid is the oil and it is used, as it must be in that process, in a proportion less than one percent of the ore, such use enabling the oleic acid which has coated the metalliferous mineral particles in the concentrate to be saponified by an alkali, and the oleic soap thus formed to be dissolved off by water and used over again in solution, to be decomposed by sulphuric acid to cause precipitation of the

oleic acid so that as an undissolved oil in the pulp it will again coat the metalliferous mineral particles. That this requires the use of less than one per cent of oleic acid is specifically stated in the New Zealand patent which we are now considering. As stated in the New Zealand patent if the proportions of oleic acid were one per cent or more the particles would adhere together and form granules and of course this would prevent the carrying on of a froth-flotation process. The possible utilization of the soap phenomena in froth-flotation when oleic acid was the oil used, was thought to be advantageous and was therefore described in patent No. 835,120, and when the soap invention or inventions (originally devised as an adjunct to the Cattermole process) were included in New Zealand in the same patent with the undissolved-oil froth-flotation invention, the possibility of this utilization was also described, although with clear demarkation of the undissolved-oil froth-flotation process from the earlier soap invention.

The two statements above quoted are followed by the description of methods that may be employed for lifting to the surface mineral particles that have been coated according to the soap process, i.e., with from 1% to 4% of a fatty acid such an oleic acid. These are the methods of attempted flotation which preceded the invention of the process of Patent No. 835,120, and have been described above in connection with the Cattermole, Sulman and Picard soap and flotation U. S. patent No. 788,247 (*supra*, p. 92).

It is to be noted that all the descriptive matter above quoted is limited to fatty acids which will coat the metalliferous mineral particles. The references to phenol and cresol are general and with no proportions given, but the soap invention required that they should be present in such amounts that, when liberated from their salts, there would be such an excess above their solubility limit as would provide the metalliferous mineral particles with adhesive coatings such as to enable these particles to adhere together or to adhere to oil-coated belts, sawdust, etc.

The impossible extravagance of using phenol or cresol in this soap process may or may not have been appreciated by the

inventors. The fact that the actual amounts of a fatty acid such as oleic acid are given, and no actual amounts of the phenol and cresol are anywhere stated, and the fact that Mr. Chapman, who was in the Sulman & Picard laboratory at the time of this invention (from September, 1899, to April, 1904, R., Vol. I, p. 597) knew nothing about any work with phenol or cresol (R., Vol. I, pp. 387, 388, Qs52, 53) and that Mr. Higgins who tested and investigated the Cattermole process from December, 1903, until it was dropped in March, 1905, knew nothing of any use of phenol or cresol in connection with the Cattermole process (R., Vol. I, p. 531, RDQ715), would indicate that the suggestion in these specifications of the use of phenol or cresol to coat metalliferous mineral particles and produce such coatings thereon as would enable the particles to adhere together or to adhere to oil-coated belts, etc., was a mere shot in the dark.

This New Zealand patent was not referred to in the testimony. It was merely offered in evidence at page 176 as one of a great number of prior documents. Thereupon defendant's expert, Professor Taggart commenced his testimony in explanation of prior documents. In that testimony he did not advert to this patent, and defendant's counsel did not call it to his attention. Therefore it was not deemed necessary to refer to it in plaintiff's rebuttal testimony.

Defendant's counsel appear to have discovered its supposed importance since the trial. They have evolved a misreading and a misinterpretation of this patent which are wholly unjustified, but which have been adopted by the Circuit Court of Appeals for the First Circuit in their opinion in the instant case. The opportunity for this misreading and misinterpretation of the New Zealand patent was afforded by the fact that the earlier soap invention and the later oil-froth-flotation invention and discovery were, for reasons merely of economy, both included in one specification in the New Zealand patent as originally taken out. The soap invention was the subject of one British patent, No. 17109 of 1903, but in the United States it had to be divided into two patents—one for soap and granulation (777,274, Cattermole, Sulman & Picard), and the other for soap and such efforts at flotation as preceded the discovery

of the oil-froth-flotation process (788,247, Cattermole, Sulman & Picard). The oil-froth-flotation process was the subject of patent No. 835,120. It may therefore be said in comparing the New Zealand patent with the United States patents that it was taken out for three inventions, since its subject-matter had to be included in three United States patents. All of these United States patents were before this Court in the *Hyde* and *Butte & Superior* cases.

Although the three inventions are described in one document, they are separately described and separately claimed. It requires only intelligent reading to separate out these three inventions (1) soap and granulation, (2) soap and skin flotation, and (3) oil-froth flotation. The two soap inventions first named are closely related, differing only in what is done with the metalliferous mineral particles *after they have been coated* with sticky or adhesive coatings, i. e., in the first they are granulated and sunk, and in the second they are raised to the surface either by causing them to adhere to metallic or other suitable surfaces (such as belts) coated with similar substances, or causing them to adhere to wood, sawdust or other suitable material lighter than water when these materials are also coated with similar substances, or causing them to be attached to chemically generated gas bubbles and lifted to the surface where it is hoped they will float as a skin float.

The mere juxtaposition of descriptions of the inventions of the three American patents specified above in one New Zealand patent adds nothing to the effectiveness of the separate disclosures of the separate American patents as anticipations of the patent in suit.

Errors of the Circuit Court of Appeals for the First Circuit as to the New Zealand patent.

The errors of the Circuit Court of Appeals in their interpretation of this three-invention New Zealand patent appear to have been principally founded upon the false chemical notion that phenol and cresol are derivatives of fatty acids, an error which appears three times in their decision (*infra*, p. 104). The

clear statement above quoted that if "the proportion of fatty acid be less than 1% of the ore * * * the coated metalliferous matter will form into a froth" is quoted by them with an error only in that "fatty acid" is pluralized into "fatty acids" (R., Vol. I, p. 650). Then they say (*id.*):

> "The words 'fatty acids' as used in that paragraph referred back to the group of fatty acids and their derivatives cresol and phenol previously mentioned."

Here the errors are (1) that "fatty acid" has been misquoted as "fatty acids," and (2) the statement that cresol and phenol are derivatives of fatty acids. Both statements are precisely wrong. The word "fatty acid" refers to only one fatty acid. It refers back to the only fatty acid previously disclosed, to wit, oleic acid; but even if it were plural and referred to a group, it could not by any possibility refer to cresol and phenol which are not fatty acids and which are not derivatives of fatty acids. Then follows the conclusion from these errors (*ib.*):

> "and plainly disclose that phenol is one of the frothing agents described in and made a part of patent No. 835,120; and if used in the fraction of 1% on the ore, the critical amount of the patent, the metalliferous matter will be coated and the froth formed."

Instead of plainly disclosing that phenol is one of the frothing agents described in and made part of patent No. 835,120, this language merely discloses that if oleic acid be used in a proportion of less than 1% on the ore, the process of granulation will be changed to froth flotation. Of course if that is done the metalliferous matter will be coated with oleic acid and a froth will be formed of the oleic-acid-coated metalliferous matter. But if phenol were used in the critical amount of patent No. 835,120, it would be completely dissolved, the metalliferous matter would not be coated at all, and the process of patent No. 835,120 could not be carried out. There would be froth formation but it would be a different froth achieved on a different principle and by a different process which involved neither preferential affinity for, nor any coating of, the mineral par-

ticles. If any one had done this ignorantly it would have been a mere accident. If anyone had done it intelligently he would have known that it could not be the process of 835,120 and that a new process had emerged. Nobody as matter of fact did it at that time either ignorantly or intelligently.

The Circuit Court of Appeals refer to the New Zealand patent as confirming their construction of patent No. 835,120, as disclosing the use of phenol as a frothing agent—a wholly unjustified construction of that patent. They also refer to it as confirming their erroneous adoption of the "adsorption theory" put forward by defendant's witness, Taggart, to wit, that mineral-frothing agents which have been completely dissolved in the water of a pulp, come out of solution and coat the metalliferous mineral particles in the process of the patent in suit. As we have heretofore shown, this adsorption theory is completely disproved by the facts (*supra*, p. 64). Both this construction and this theory are completely disproved by the record. The New Zealand patent in its juxtaposition of the subject-matter of three United States patents clearly distinguishes and delimits each invention from the other, and its description, when properly understood, is helpful in this delimitation. It utterly fails to support either the construction stated of patent No. 835,120 or the adsorption theory of Prof. Taggart.

Errors of the Circuit Court of Appeals in the instant case in interpreting statements of the Patent in suit relative to prior patents and processes.

The statement as to prior processes in the specification of 962,678 commences as follows (Spec. p. 2, lines 17-20):

> "Hitherto many proposals have been made for the wet concentration of ores involving the addition to the liquid in which the ore is suspended of an immiscible liquid."

This is erroneously interpreted by the Circuit Court of Appeals in the instant case, the quotation of the above sentence being preceded by the following statement (R., Vol. I, p. 642):

> "In attempting to differentiate the mineral-frothing agents of the patent which it discloses as being in solution, from the mineral-frothing agents of the prior art used in the concentration of ores, the patentees state:"

This statement is quite erroneous.

First Error: What the patentees primarily refer to are prior *processes* and not *agents*.

Second Error: The only prior processes referred to wherein a mineral-bearing froth was formed are the process of patent No. 835,120 and of a few unimportant related patents. Therefore, these were the only prior processes wherein a mineral-frothing agent was used. The agents disclosed in the patents describing these processes were immiscible substances which preferentially coated the metalliferous mineral particles and did not coat the gangue particles; and the processes operated by reason of forces that came into play as a result of the fact that the metalliferous particles were coated with oil and that the gangue particles were not coated with oil.

Third Error: The first of the prior processes referred to not only was not a froth-flotation process, but it was not even a flotation process. It was the antithesis of a flotation process. It was a metal-sinking process, in which recovery of the metalliferous mineral was effected by sinking it, and everything that floated went to waste. So completely was this prior process misunderstood by the Circuit Court of Appeals in the instant case, that they called it a "flotation process" as will appear.

This prior metal-sinking process first specifically referred to is identified and quite fully described in the specification of the patent in suit, as follows (Spec. p. 2, lines 20-31):

> "For example, in the patent granted to Cattermole, Sulman & Picard, United States No. 777,274, dated December 13th, 1904, is described a process of ore concentration in which metalliferous particles were coated with a thin film of a fatty or resin acid or a phenol or a cresol by introducing the alkaline compounds of these

materials into an acid liquid whereby these materials were liberated in an immiscible or insoluble condition and adhered to the mineral particles."

That patent is known as the soap and granulation patent. It may be noted here that the patent in suit accurately states as to that patent that it disclosed the liberation from other compounds, by chemical decomposition of those compounds, of a phenol or a cresol, or a fatty acid such as oleic acid, or a resin acid, "in an immiscible or insoluble condition" and so that it "adhered to the mineral particles" (Spec., p. 2, lines 29-31) with the result that the "metalliferous particles were coated with a thin film of a fatty or resin acid or a phenol or a cresol" (Spec., p. 2, lines 25-27). It may be also noted that the process of that patent required that this coating film of phenol or cresol, or fatty or resin acid, should be such a coating as would cause the coated metalliferous particles to adhere or stick together into granules (and not adhere to air bubbles) and that they should be recovered by a sinking operation (and not by flotation).

The process described in that Cattermole, Sulman & Picard patent No. 777,274, is, as above noted, a metal-sinking process wherein the only recovery of metalliferous mineral is of the particles that sink, and wherein any metalliferous mineral particles that floated would flow off with the tailings and be lost.

This Court in the *Hyde* case referred as follows to that class of process and to the companion Cattermole patent No. 777,273 (242 U. S. 261):

> "The process of the other class, called in the record the 'Metal Sinking Process,' reverses the action of the Surface Flotation Process and is illustrated by the Cattermole U. S. patent, No. 777,273 * * *.
>
> "It is obvious that the process of the patent in suit [835,120], as we have described it, is not of the Metal Sinking class, * * *."

Patent No. 777,274 was before this Court in the *Hyde* case and was another illustration of this metal-sinking process.

Yet in the opinion of the Circuit Court of Appeals for the First Circuit in the instant case it is said, referring to the

process of Cattermole, Sulman & Picard patent No. 777,274 (R., Vol. I, p. 642):

> "That process is known as the skin flotation process."

This error shows a complete misunderstanding of the disclosures of this prior patent.

Then follows in the opinion this statement, referring to that same patent No. 777,274 (*ib.*):

> "Its specification discloses that the fatty or resin acids, or their derivatives cresol and phenol, are soluble compounds and that the improvement of that patent consisted in the method of thoroughly dispersing these compounds, due to their solubility, throughout the pulp in admixture with the mineral particles suspended in the ore mass; that when thus disseminated a small amount of mineral acid is added which decomposes the compound used, thus liberating the compound in intimate contact with the mineral particles which adhere thereto."

This description contains at least three outstanding errors.

First Error. The prior specification referred to does not disclose that the fatty and resin acids and phenol and cresol are soluble compounds. Its disclosure is quite to the contrary. There is no thought of utilization of solubility in any part of this prior specification as applied to these substances, nor is there any possibility of the utilization of solubility of these substances in the process of this prior patent. Any portion of these substances which dissolved would be useless in the process. The functioning of the process is dependent upon insolubility of the fatty and resin acids and phenol and cresol. The patent provides a method of chemically producing these substances *in situ* in the pulp from soluble substances (soaps or salts) which have been introduced into the pulp and readily diffused therein by reason of their solubility, and the purpose of the process is to liberate *in situ* fatty or resin acids or phenol or cresol "in an immiscible or insoluble condition." A soap of a fatty or resin acid, or the soluble alkaline salt of cresol or

phenol (a cresylate or a phenylate) is introduced into the pulp and dissolved in the water of the pulp and when dissolved may be easily diffused uniformly through the pulp. Then by chemical action, to wit, the decomposing action of sulphuric acid, the fatty or resin soap or the phenylate or cresylate is decomposed and thereby the fatty or resin acid or phenol or cresol is formed *in situ* and is precipitated from solution in a state of very fine subdivision and "in an immiscible or insoluble condition" and preferentially and selectively coats the metalliferous mineral particles and forms upon these particles a sticky or adhesive coating, and the metalliferous mineral particles, thus covered with the sticky or adhesive coating of fatty or resin acid or phenol or cresol, are caused by the agitation to contact and to adhere together in small masses or granules which are later separated from the gangue particles by sinking them in an up-current of water strong enough to carry away to waste the gangue particles and with them everything that floats or tends to float. While the fatty and resin acids are completely insoluble substances, phenol and cresol have a limited solubility. Six pounds of phenol will dissolve in one hundred pounds of water (R., Vol. I, p. 347, Bacon, Q32). Therefore, in this process a definite excess over and above 6 pounds of phenol must be used for every 100 pounds of water and such excess above the 6 pounds is available and is utilized in the coating process and the 6 pounds per 100 pounds of water is dissolved away and lost to the process. The solubility of cresol is one-half that of phenol (R., Vol. I, p. 507, Higgins, XQ557), so a definite excess over and above 3 pounds of cresol must be used for every 100 pounds of water and all such excess over the 3 pounds is available and is utilized and the 3 pounds per 100 pounds of water dissolved away and lost to the process.

The Circuit Court of Appeals in the instant case has simply confused the soaps or salts which were put into the pulp and which wholly dissolved and were therefore powerless to coat anything, with the agents themselves which were produced by the chemical decomposition of these soaps or salts and which functioned solely by reason of insolubility and coating.

The second error in the above quotation is the statement that cresol and phenol are derivatives of the fatty or resin acids. They are not. In the process the fatty and resin acids are derivatives of their own soaps, since they are formed by chemical action from solutions of their soaps. The phenol and cresol are derivatives of their soluble salts (phenylates and cresylates) since they are formed by chemical action from solutions of these soluble salts.

This curious error of describing cresol and phenol as derivatives of the fatty and resin acids appears three times in the opinion of the Circuit Court of Appeals for the First Circuit. In addition to the statement above quoted at page 642, it appears again at page 648 near the bottom of the page, and appears again at page 650 at the beginning of the third paragraph. The erroneous notion that cresol and phenol are derivatives of fatty acids appears to some extent to account for the erroneous view that phenol is disclosed in patent No. 835,120 as one of the frothing agents of that patent, which might be called the basic concrete error of the opinion.

Returning to the above quoted first reference in the opinion relative to patent No. 777,274, *the third error* therein is the statement that "the improvement of that patent consisted in the method of thoroughly dispersing these compounds, due to their solubility, throughout the pulp in admixture with the mineral particles suspended in the ore mass." The error here is that the compounds are not dispersed "due to their solubility," but they are dispersed due to the solubility of other compounds—their soaps or salts—from which they are afterward derived by chemical decomposition. The process starts with the soap of a fatty or resin acid, or with a phenylate or a cresylate. These substances are readily soluble and they are easily dispersed through the pulp. After the soap or the phenylate or the cresylate has been thus dissolved and dispersed throughout the water of the pulp, it is decomposed by sulphuric acid and the fatty acid or the resin acid or phenol or cresol is formed and precipitated from solution, and preferentially and selectively coats the metalliferous mineral particles with which its undissolved

particles or globules are brought into contact. In the case of a fatty or a resin acid all of it is precipitated and coats the metalliferous particles; in the case of phenol or cresol, only that part of it is precipitated and coats the metalliferous particles which does not go into solution, and only that part of it which does not go into solution performs any useful function in this Cattermole metal-sinking process.

The concluding portion of the above quotation is the statement that, when a small amount of mineral acid is added, it "decomposes the compound used, thus liberating the compound in intimate contact with the mineral particles which adhere thereto." This shows again the utter confusion in the mind of the Court of "the compound used" (the soluble soap or salt) with "the compound which adheres" to "the mineral particles" (the insoluble fatty acid, etc.).

Then in the patent in suit there is a reference to "another known process" (Spec., p. 2, l. 32) which is described as a film-flotation process not employing oil, wherein "the powdered ore suspended in water, preferably acidified, is mechanically brought to the surface whereby the particles are exposed to the air" (Spec., p. 2, ll. 32-35). This is the attempted flotation of unoiled metalliferous mineral particles like wood chips on the surface of water. This known process is so remote from the process of the patent in suit that the defendant did not put in any evidence describing it.

Although this process is quite fully described in the patent in suit, the Circuit Court of Appeals for the First Circuit in the instant case failed to comprehend the description and said (R., Vol. I, p. 642):

> "The specification then refers to another prior art flotation process but does not specify the agent employed."

First, this is not "*another* prior flotation process" since the process just previously described was not a flotation process at all, and second, the only agent employed, to wit, a soluble acid, such as sulphuric acid, is at least indicated in the statement that the water is acidified.

It may be further added that this prior flotation process, depending for flotation upon "the properties of the metalliferous particles themselves when exposed to air or other gas and brought onto the edge or surface of water preferably acidified" (Spec., p. 2, ll. 42-46) and "mechanically brought to the surface whereby the particles are exposed to the air" (Spec., p. 2, ll. 34, 35) is properly describable by the term "skin flotation process" which the Circuit Court of Appeals for the First Circuit erroneously used to describe the metal-sinking process of the Cattermole, Sulman & Picard patent No. 777,274.

It may be noted that the patentees have in the paragraph above referred to (Spec., p. 2, ll. 17-46) given an example of a metal-sinking process utilizing adhesively coated mineral particles, and of a film-flotation process not utilizing oil coatings. They then proceed to point out (Spec., p. 2, ll. 53-57) that their present process differs from these and other known processes by the use of a "mineral-frothing agent in solution" and by the fact that the metalliferous particles are brought to the surface in the form of a froth or scum, "not by mechanical means but by the attachment of air or other gas bubbles thereto."

Then follows the statement (Spec., p. 2, ll. 58-61):

> "In the frothing processes hitherto known the substances used to secure the formation of a mineral-bearing froth has been oil or an oily liquid *immiscible with water.*"

These priorly known frothing processes are that of patent No. 835,120 and such suggested variations thereof as appear, for example, in the superaeration patent No. 835,479 to Sulman, Picard & Ballot of Nov. 6, 1906, and the boiling patent No. 835,143 to Sulman of November 6, 1906, in so far as carried out with the minimum amount of oil characterizing the process of patent No. 835,120. This statement of the patent in suit is precise, accurate and truthful. The Circuit Court of Appeals for the First Circuit, however, quotes it and says that it is completely refuted by the opinion of this Court in the *Butte & Superior* case (R., Vol. I. p. 648), basing its conclusion upon errors in quoting the opinion of this Court and unjustified interpolations therein completely changing the meaning of the language used. We have treated of this at page 80, *supra*.

Errors of the Circuit Court of Appeals for the First Circuit in the instant case relative to the disclaimer in the patent in suit.

The disclaimer appears at page 2, lines 69-77 and is as follows:

> "It is well known that certain of the organic substances we have referred to are not soluble in water in all proportions and that if used in excess might partly remain insoluble in the acidified water and might become mechanically affixed to the metalliferous particles of the ore. We disclaim any such use of these substances and only claim them in such amount as will enable them to dissolve in the acidified water."

This disclaimer merely accentuates the affirmative disclosures of the specification that the process is one employing mineral-frothing agents in solution. Obviously even the same physical substance if used under conditions which prevent its going into solution cannot function as a part of the process disclosed and patented.

Defendant's process employs as the only mineral-frothing agent a substance which completely dissolves in the water of the pulp. As is shown hereinafter (*Infra,* p. 129), defendant uses such a small proportion of this agent (alpha-naphthylamine or X-cake) that the amount used is only one thirty-fourth of the amount that would wholly dissolve in the water of defendant's pulp. This disclaimer, therefore, however interpreted and applied, cannot relieve the present defendant from infringement.

Nevertheless there has been much contention here as to the meaning of the disclaimer by reason of the fact that in many instances of the use of the invention of the patent in suit in the practical art there has been a conjoint use of the process of patent No. 835,120 (involving an undissolved mineral-frothing agent) and of the process of the patent in suit (involving a mineral-frothing agent in solution). This was the situation in the *Miami case* and there both patents were held to be infringed. But in no instance in the art has a froth-flota-

tion process been practiced wherein soluble substances were used as mineral-frothing agents in quantity in excess of their solubility or under conditions which prevented their going wholly into solution. Consequently the conditions set out in the disclaimer have never been met in practice at any time either before or since the issue of the patent in suit. Pine oil may be taken as an example of a complex mixture of substances including both classes of mineral-frothing agents. The fact that it is "a mixture of a lot of different chemical compounds" of variable content depending upon the process of manufacture, was stated by defendant's expert, Professor Taggart (R., Vol. I, pp. 219-220, Q58). As Mr. Higgins testifies (R., Vol. I, p. 491, XQ461):

> "A. Pine Oil contains a mixture of a good many substances—chemical substances—several of which are soluble and others insoluble. Both are mineral-frothing agents."

Therefore, the use of this complex manufactured mixture of substances in a froth-flotation process involves the use both of an insoluble mineral-frothing agent and of a soluble mineral-frothing agent, in which the process of patent No. 835,120 and the process of the patent in suit are conjointly used, or, as Mr. Higgins testifies, it involves "the use of the patent in suit, together with the use of the process of patent No. 835,120."

This conjoint use of the two processes has been found to be highly beneficial—better for some ores than either process alone. Neither process hinders or prevents the other process. Apparently each helps the other. This is clearly not the thing disclaimed in the patent in suit. It does not involve the use of a soluble mineral-frothing agent in a quantity in excess of its solubility. Therefore, the disclaimer, however interpreted, cannot apply to such a conjoint use of the two processes.

The errors and confusion of the Circuit Court of Appeals for the First Circuit in regard to this matter probably arose from considering pine oil as a single substance, notwithstanding the positive testimony in behalf of both parties to the contrary. That particular error might have been unimportant had

it not entered into the misunderstanding and misconstruction by the Circuit Court of Appeals of the First Circuit of the decision of this Court in the *Butte & Superior* case.

Other errors of the Circuit Court of Appeals in the instant case in interpreting the patent in suit.

Prior patent No. 835,120 for a process of froth-flotation employing undissolved mineral-frothing agents, gives a general definition of substances which may be used in that process as

> "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue."

The Circuit Court of Appeals reaches the conclusion that many of the substances named in the patent in suit as mineral-frothing agents in solution are included within this definition of patent No. 835,120.

But this is error.

Any substance, in order to exercise this preferential affinity, must remain undissolved in the water of the pulp in the form of particles or globules disseminated through the pulp and repelled by the water so that they escape from the water to the surface of the metalliferous particles and coat them. This old and well-known quality of oils was utilized in the process of patent No. 835,120, and where the oil globules were present in such small amount that the resultant coating of metalliferous mineral particles would not cause those particles to adhere together and form granules but would cause them to adhere to air bubbles and form froth, the process of patent No. 835,120 would be carried on.

On the other hand a typical example of a soluble mineral-frothing agent of the process of the patent in suit is acetic acid or vinegar, and its qualities in the presence of water as contrasted with oily substances are well-known. It is soluble in all proportions in water (Higgins, R., Vol. I, pp. 530-531, RDQs709-712), so that in whatever quantity used it completely dissolves.

The patent in suit gives as examples of substances which will act as mineral-frothing agents in solution (R., Vol. II, p. 664, Spec., p. 1, ll. 33-36):

> "amyl acetate and other esters; phenol and its homologue; benzoic, valerianic and lactic acids; acetones and other ketones such as camphor."

These are all substances which in the small proportions specified in the patent in suit, are completely dissolved and cannot function to coat the mineral particles preferentially as do the undissolved oil globules of patent No. 835,120. Specimens are in evidence of amyl acetate (Plaintiff's Exhibit 22), its solution in water (Plaintiff's Exhibit 27), phenol (Plaintiff's Exhibit 23), its solution in water (Plaintiff's Exhibit 28), benzoic acid (Plaintiff's Exhibit 24), its solution in water (Plaintiff's Exhibit 29), lactic acid (Plaintiff's Exhibit 25), its solution in water (Plaintiff's Exhibit 30), and camphor (Plaintiff's Exhibit 26) and its solution in water (Plaintiff's Exhibit 31). These solutions are all in the proportions specified in the patent in suit.

The Court will see that amyl acetate is a colorless liquid not oily at all, and that it gives a clear and brilliant solution. When a bottle of amyl acetate (Plaintiff's Exhibit 22) is shaken a few large bubbles are entrapped (Higgins, R., Vol. I, p. 547, RDQ773). When its solution (Plaintiff's Exhibit 27) is shaken, if there be also air in the bottle, there is a tremendous development of bubbles and they are exceedingly fine bubbles (p. 548, RDQ774).

It happens that amyl acetate is known in commerce as banana oil, just as sulphuric acid is known as oil of vitriol. Neither of them are oils in the sense of patent No. 835,120. A trade name cannot change the nature of a substance. Yet the Circuit Court of Appeals apparently thinks that it can.

Amyl alchohol is a substance not specifically named in the patent in suit, but it is an amyl compound which is a mineral-frothing agent in solution within the scope of the claims in issue. As Professor Taggart states (R., Vol. I, p. 241, Q117) "fusel oil contains amyl alcohol."—that is, amyl alcohol is one

of the constituents of fusel oil. Obviously it is not proved to be an oil by proving that it is a constituent of the substance commercially known as "fusel oil."

The Circuit Court of Appeals says as to these two substances (R., Vol. I, p. 649):

> "Amyl acetate known in commerce as banana oil, and amyl alcohol commonly known as fusel oil, both of which are specifically mentioned as mineral-frothing agents in the patent in suit (962,678), have a preferential affinity for metalliferous matter and are undoubtedly oils of the prior art. Amyl acetate is soluble in water in the proportions used of a fraction of one per cent on the ore."

In other words, because amyl acetate is known in commerce as banana oil, and notwithstanding the fact that when used in the proportion of a fraction of one percent on the ore it would be completely dissolved, the Circuit Court of Appeals classifies it as one of the oils of patent No. 835,120 having "a preferential affinity for metalliferous matter." This is clear error. Not only is it not disclosed or referred to in patent No. 835,120, but it utterly fails to come within the broad definition of substances which may be considered as "oils of the patent" having a preferential affinity for metalliferous matter. Its use in the water of an ore pulp does not result in the presence in that water of any undissolved oil globules. It does not by reason of repulsion of water and preferential affinity for metalliferous particles selectively coat the metalliferous mineral particles in an ore pulp. The same is true as to amyl alcohol, which is not "specifically mentioned" in the patent in suit.

Valerianic acid is admittedly completely soluble in water in the proportions used in flotation. Although it may be chemically classed as a fatty acid, it has none of the qualities of the fatty acids which were used in the prior flotation art and which were essentially saponifiable fatty acids, such as oleic acid, the single example in patent No. 835,120. Oleic acid is physically an oil, is insoluble in all proportions, is derived from fats and is capable of being chemically changed by an alkali into a soap which will dissolve in water, this soap being capable in turn

of being decomposed by an acid so as to liberate again the insoluble oleic acid but now in a state of fine division disseminated throughout the water of the pulp and ready to be forced upon the metalliferous particles by its repulsion by water and its preferential affinity for these particles. This is the soap phenomenon of Cattermole, Sulman & Picard patent No. 777,274 (see *supra*, p. 91). Obviously valerianic acid is not within the category of the fatty acids of patent No. 835,120 and the prior art, and obviously also by reason of the fact that it completely dissolves in the proportions used in flotation it cannot be present in the solution in the form of undissolved globules to preferentially coat the metalliferous mineral particles. Yet, as to this substance, completely soluble when used, the Circuit Court of Appeals says (R., Vol. I, p. 649):

> "Valerianic acid is a soluble mineral-frothing agent specifically named in the patent in suit and is a fatty acid of the prior art patents Nos. 835,120 and 777,274."

This was clear error.

Benzoic acid is a white, crystalline solid, flaky in appearance (Higgins, R., Vol. I, p. 548, RDQ776). A specimen is in evidence as Plaintiff's Exhibit 24, as well as a clear and brilliant solution of it in froth-flotation proportions (Plaintiff's Exhibit 29). Being completely soluble, it does not have preferential affinity for, nor can it coat, the metalliferous material in an ore pulp. Although a solid substance, it is said to be chemically a resin acid, but obviously it is not such a resin acid as the prior art patent to Cattermole, Sulman & Picard No. 777,274 mentions, since that disclosure requires a saponifiable resin acid, i. e., one capable of being made into a soluble soap by the action of alkali. Yet, as to this solid substance, completely dissolved when used, the Circuit Court of Appeals says (R., Vol. I, p. 649):

> "Benzoic acid is also one of the soluble mineral-frothing agents specifically mentioned in the patent in suit. It has a preferential affinity for metalliferous matter over gangue and is therefore included within the terms referred to in patent No. 835,120 as 'other substances' and

is also included among the resin acids of Cattermole 777,274."

This was clear error.

Phenol is named as a mineral-frothing agent in solution in the patent in suit, and the term "its homologues" includes cresol. Phenol is a normally solid substance familiar in a solution known as carbolic acid. A specimen of it is in evidence (Plaintiff's Exhibit 23), as well as its clear and brilliant solution in water in the proportions specified in the patent in suit (Plaintiff's Exhibit 28). Although in the proportions used it completely dissolves, it has only a limited solubility and it is mentioned in the Cattermole, Sulman & Picard patent No. 777,274 as useful to coat metalliferous mineral particles in an ore pulp so as to provide an adhesive coating which will enable them to be rolled up into granules and separated by sinking. Its use for such purpose involves the useless dissolving of a certain amount of it, up to the point of saturation, and it is only above that point that its undissolved portion is useful in this granulation process. The same is true as to cresol, except that it is only one-half as soluble as phenol and, therefore, less of it would be required and more of it would be useful if anyone were to use it in the Cattermole granulation process. Neither of these substances is referred to in patent No. 835,120, and if used in the proportions of that patent they would go completely into solution and would have no preferential affinity for metalliferous matter over gangue whatever and could not carry out the process of that patent. They are, therefore, when so used not among the oils or oily liquids or other substances of that patent as they have been defined by this Court. This has heretofore been considered, but it may be noted here that the patent in suit very clearly differentiates from the prior disclosure in patent No. 777,274 of the use of undissolved phenol or cresol for coating metalliferous mineral particles in an ore pulp so as to permit granulation of the adhesively coated particles. As to these substances the Circuit Court of Appeals said (R., Vol. I, p. 649):

> "Phenol and cresol named or referred to as soluble mineral-frothing agents in the patent in suit are specifically

named in the prior art patent of Cattermole (777,274) and are among the oils or oily liquids of patent No. 835,120."

This is clear error.

This is followed by a statement of the conclusion that as phenol is one of the oils or oily liquids of patent No. 835,120 (although it is not therein mentioned or referred to) that patent, No. 835,120, anticipates the patent in suit.

Error of the Circuit Court of Appeals in the instant case in regard to the Conjoint Use of the Process of Patent No. 835,120 and of the process of the Patent in Suit.

In the *Miami* case as aforesaid the Circuit Court of Appeals for the Third Circuit found that these two processes were conjointly used by the defendant there, and held such conjoint use to be an infringement of both patents.

This conjoint use may be well illustrated by the use of the complex material known as pine oil as a mineral-frothing agent in a process of ore concentration. Pine oil is made up in part of substances—chemical compounds—that do not dissolve in the water of the pulp and so are adapted to preferentially coat the metalliferous mineral particles, and in part of substances —chemical compounds—that do dissolve in the water of the pulp and so are unable to coat anything in the pulp. The substances that do not dissolve are oily mineral-frothing agents and clearly are oils of patent No. 835,120 for they have a preferential affinity for the metalliferous mineral particles. The substances that do dissolve act as mineral-frothing agents in solution and are within the scope of the claims in issue. They are not used in excess of their solubility and therefore their use is clearly not the thing disclaimed in the patent in suit. If these two classes of substances constituting pine oil were separated and those of either class were used alone, they would achieve a froth-flotation process, the one by the principle of operation of patent No. 835,120 (if used in sufficiently small quantity) and the other by the principle of operation

of the patent here in suit. When the complex material is used without separation into its two classes of constituent substances, it has been found that neither impairs the operation of the other but that the conjoint use of both classes of substances is advantageous.

Defendant in the present case carries on only the process of the patent in suit. Defendant's mineral-frothing agent is the single chemical substance alpha-naphthylamine which goes completely into solution in the operation of defendant's process and is used in a quantity far below the saturation point.

The defendant brought out in its evidence the complex nature of the material known as pine oil (Taggart, R., Vol. I, pp. 219, 220, Q58) and in the cross-examination of Mr. Higgins brought out the character and quality of the constituent substances of this complex material (R., Vol. I, p. 491, XQ461), and the evidence as to commercial use of the process of the patent here in suit shows a large conjoint use of the two processes from 1912 on in the employment of pine oil and the various creosotes and tars by many of plaintiff's licensees (R., Vol. II, pp. 695, 712).

The Circuit Court of Appeals in the instant case, after discussing the disclaimer in the patent in suit, says (R., Vol. I, p. 644):

> "But in this case (see R., Vol. I, pp. 492, 503) and elsewhere the plaintiffs have contended for a broader construction or scope of the patent and have claimed that organic compounds partly immiscible and partly soluble in water were within the scope of the patent and that such use was an infringement; and apparently they have obtained a decision to that effect in *Miami Copper Co.* v. *Minerals Separation, Limited*, 244 Fed. 752, on the ground that the use of an oil that went in part into solution, the balance remaining immiscible, was a conjoint use of the patent in suit and of patent No. 835,120, if the immiscible part was used in a fraction of one per cent on the ore. We do not now stop to consider the soundness of this contention and holding, for it is not directly involved in this case, although it will be considered later."

The "contention and holding" as to conjoint use of the two processes "is not directly involved in this case" as the Circuit

Court of Appeals says, because the defendant here does not use a complex mixture of substances some constituent parts of which are soluble and some insoluble (as in the *Miami* case) but uses a simple substance that is wholly soluble.

The record references in the above quotation are significant because they indicate the confusion of mind of the Circuit Court of Appeals in this matter. The references are to the cross-examination of plaintiff's expert witness Mr. Higgins. The first reference is to R., Vol. I, p. 492, wherein he was asked for his opinion as to the use of phenol in the process in excess of its solubility, and expressed the opinion that if it were thus used and the amount of it in excess of its solubility were less than one per cent of the weight of the ore, that would be a conjoint practice of the process of patent No. 835,120 and of the process of the patent here in suit. This record reference betrays confusion of thought in the matter for that was not what the defendant in the *Miami* case used or what the Circuit Court of Appeals for the Third Circuit referred to as conjoint use. It also appears that such use of phenol would require in excess of 500 pounds (one quarter of a ton) to the ton of ore (Higgins, R., Vol. I, p. 507, XQ559). Since no one ever used phenol in anything approaching these proportions, the question is purely academic. No question of that character has ever arisen or can ever arise in the construction of the patent in suit.

The second of these references (R., Vol. I, p. 503) is to the cross-examination of Mr. Higgins wherein there is an indefinite reference to the use of an agent a constituent of which is a mineral-frothing agent in solution, the other constituents of which remain undissolved in the ore pulp. So far as developed this would appear to be parallel to the use of a complex agent such as pine oil wherein, as above stated, certain constituents or chemical compounds act as mineral-frothing agents in solution and the other constituents or chemical compounds act as oils of patent No. 835,120, and none of the constituents or compounds that are mineral-frothing agents in solution is used in excess of its solubility. That is the question that was decided in the *Miami* case. As to that the Circuit Court of

Appeals in the instant case further said (R., Vol. I, pp. 651, 652):

> "In the *Miami Copper* case, *supra,* the litigation involved both patent No. 835,120 and the patent here in suit No. 962,678. The agent employed by the defendant in its infringing process was partly soluble and partly insoluble, and the use of such an agent in a fraction of one per cent on the ore was held to infringe both patents on the ground that it was a conjoint use of both. While such use was *plainly within the scope of the disclosure of the first patent* (No. 835,120) and an infringement of it, it was not within the scope and an infringement of the second patent, for even assuming that the second patent is valid, its scope, as previously pointed out, is limited to the use of an agent that is wholly in solution in water. This being so, the use of the agent there employed was not within the scope and an infringement of the second patent. *We, therefore, decline to follow the decision in the Miami case.*"

It will be noted that the Circuit Court of Appeals in the instant case seemed here, when speaking of 835,120, to confuse "scope of the disclosure" with scope of the claim; and further they overlooked or failed to comprehend the testimony as to the complex nature of the materials used where those materials contained not only substances which are insoluble mineral-frothing agents but also entirely different substances which are soluble mineral-frothing agents and were not used in excess of their solubility. The disagreement, however, with the Circuit Court of Appeals for the Third Circuit covered the whole subject of the validity of the patent here in suit, to wit, the whole scope of the opinion of the Circuit Court of Appeals in the instant case.

The conflicting decision in the Third Circuit Minerals Separation, Limited v. Miami Copper Company.

Three patents were in suit in that case. The first was No. 835,120, the patent held in the instant case to anticipate the patent in suit. The second was No. 962,678, the patent here in

suit. The third was No. 1,099,699, which is in evidence here. All three were there held to be valid and infringed.

The first patent No. 835,120 was pleaded as an anticipation of the second patent, the patent here in suit. The Cattermole patent No. 777,273 and the Cattermole, Sulman & Picard patent No. 777,274 were there also before that Court as alleged anticipations of the second patent there, the patent here in suit, and the effect of the references in patent No. 835,120 to these two Cattermole patents and the reference in the patent here in suit to the last mentioned Cattermole patent, were very fully argued. Indeed the only patent referred to in the decision of the Circuit Court of Appeals in the instant case which was not before the Circuit Court of Appeals for the Third Circuit in the *Miami* case and there considered as an alleged anticipation of the patent here in suit, is the New Zealand patent held by the Circuit Court of Appeals in the instant case to confirm its construction of patent No. 835,120, erroneously as we have seen.

The argument in the Circuit Court of Appeals in the *Miami* case occurred after the decision in this Court in *Minerals Separation, Limited* v. *Hyde* (Dec. 11, 1916). The decision in the *Miami* case preceded the decision of this Court in *Minerals Separation, Limited* v. *Butte & Superior Mining Company* (June 2, 1919). Hence we find in the decision in the Third Circuit in the *Miami* case a careful consideration of the decision of this Court in the *Hyde* case, and we find in the decision of this Court in the *Butte & Superior* case that the *Miami* case is cited in a footnote (250 U. S. at 338) as one of the cases wherein patent No. 835,120 had been described in court proceedings.

Judges Buffington, McPherson and Woolley, Circuit Judges, heard the argument, and the opinion of the Court was written by Judge Woolley. Judge Buffington dissented, but his dissenting opinion only discussed the construction of patent No. 835,120 and the question of infringement of that patent.

In pointing out the difference between the first and second patents there in suit, Judge Woolley said of the process of the second patent, the patent here in suit (244 Fed. at 771):

"It is also an air-froth flotation process but differs from the first patent, although both processes may be, and both actually are, employed conjointly. Its essential feature is the use of a mineral-frothing agent in solution."

After quoting at large from the specification, including claims 1 and 2 which were there and are here in suit, and also including claims 5 and 6 which were there additionally in suit and which included "beating air into" the pulp, Judge Woolley continues (p. 773):

"The difference between the two patents may be shortly stated to be this: The first process rests upon the use in very small quantity of an oily substance that does not dissolve in water, coupled with agitation of the pulp, and this succeeds in producing a special froth that is remarkably effective in recovering the minute particles of ore. The second process does not employ oil, or an undissolvable substance; on the contrary, the 'mineral-frothing agent' must be in solution, and ex vi termini must therefore be dissolvable. The specification disclaims the use of so large a quantity that part of it remains undissolved. The 'mineral-frothing agent' is further limited by describing it as 'one or more organic substances which enable metallic sulfids to float under conditions hereinafter specified'; and, as this general statement does not convey specific information, the patentees give several examples of organic substances that are found to be suitable for use in solution. In passing we may note that claims 1 and 5 are broad enough to cover inorganic frothing agents also, but as no such agent is yet known this feature need not now be considered. Just how or why this solution with the needful agitation produces the froth, is not certainly known; but the fact is, that (to use the language of the brief):

'* * * Its effect [is] to produce a similar action of air bubbles in the attraction of metallic particles, a similar levitation of the metallic particles, a similar persistence of the bubbles, a similar reliable adherence of the air bubbles to the metallic particles, and a similar capacity for final separation of the metallic particles by their overflow, still in attachment to air bubbles, at the top of a vessel containing the pulp.'

> "An observable difference in effect is that the froth of the second patent is composed of bubbles much smaller than the bubbles of the oil process. * * *
>
> "We do not find it necessary to discuss the question of validity; our conclusion is, that the patent discloses invention and has not been anticipated. As in the case of the oil process, the patentees seem to have taken 'the final step which converted experiment into solution, turned failure into success.' *Minerals Separation Co.* v. *Hyde,* 242 U. S. 261, 37 Sup. Ct. 82, 61 L. Ed. 286. And we find nothing in the prior art that can be held to anticipate."

It will be noted that the Circuit Court of Appeals for the Third Circuit, after stating that the distinguishing feature of the process of the patent here in suit No. 962,678 is the use of a mineral-frothing agent in solution, defines that agent as follows:

1. It "must be **in solution,** and ex vi termini must therefore be dissolvable"; in contrast to the undissolvable substance, oil, of 835,120.

2. It must be a **"mineral-frothing agent"** which is further defined and limited by describing it as **"one or more organic substances which enable metallic sulfids to float under conditions hereinafter specified."**

Summary and authorities as to conflict between the Circuit Court of Appeals for the Third Circuit in the Miami Case and the Circuit Court of Appeals for the First Circuit in the instant case as to Anticipation of the Patent in Suit by Patent No. 835,120.

The two Courts had the same documents before them, with a few minor exceptions, the only one referred to in the opinion of the Circuit Court of Appeals for the First Circuit being the New Zealand patent heretofore discussed which we have shown does not alter the situation one iota.

The two Courts had the same facts before them excepting only the speculative theories of defendant's experts but we have

shown that those theories do not change or alter by a hair's breadth the disclosure of patent No. 835,120.

The facts presented to the two Courts on the issue of anticipation were the same.

While the Circuit Court of Appeals for the Third Circuit in the *Miami* case did not find it necessary to discuss the question of validity of the patent here in suit, No. 962,678, claims 1 and 2, and merely stated its conclusion "that the patent discloses invention and has not been anticipated * * * and we find nothing in the prior art that can be held to anticipate," they accurately stated the differences between the two patents, Nos. 835,120 and 962,678, and accurately compared the defendant's process there with the claims of patent No. 962,678 and concluded as to the process of the patent here in suit:

> "as in the case of the oil process, the patentees seem to have taken 'the final step which converted experiment into solution, turned failure into success' *Minerals Separation Company* v. *Hyde,* 242 U. S. 261, 37 Sup. Ct. 82, 61 L. ed. 286."

The Circuit Court of Appeals for the First Circuit in the instant case made error after error as we have pointed out, errors of fact on the technical side, misunderstanding processes and descriptions of processes and misinterpreting technical terms of the art, and made errors of law in misinterpreting decisions of this Court and in substituting speculative theories, unproved and unprovable, for the simple facts set out simply in the documents under comparison, demonstrated by the simple tests of those who were expert in the practical art, evidenced by the simple and straightforward reasoning and opinions and experience of those practical experts, and conclusively established by the history of the practical art before and after the advent of the process of the patent in suit.

The conclusion that the Circuit Court of Appeals for the Third Circuit was right and that the Circuit Court of Appeals for the First Circuit is wrong is fortified by *the presumption arising from the issue of the patent* in suit four years after the issue of the patent No. 835,120.

In *Gandy* v. *Main Belting Co.*, 143 U. S. 587, the lower Court had dismissed the bill on several grounds, one being that of anticipation. In this court the defenses of lack of novelty and lack of patentability were vigorously asserted, but this Court sustained the patent, saying:

> " 'The patent is *prima facie* evidence both of novelty and utility, and neither of these presumptions has been rebutted by the evidence.' "
> *Railroad* v. *Stimpson*, 14 Peters, 448;
> *Corning* v. *Burden*, 15 How. 252;
> *Blanchard* v. *Putnam*, 8 Wall. 420;
> *Mitchell* v. *Tilghman*, 19 Wall. 287;
> *Bates* v. *Coe*, 98 U. S. 31.

The conclusion that the Circuit Court of Appeals for the Third Circuit was right and that the Circuit Court of Appeals for the First Circuit in the instant case is wrong is further fortified by *the proved benefit* that the inventors by the process of the patent in suit have *conferred upon society*, a boon to the metallurgical world of unprecedented magnitude, and by the *enormous public demand* for and use of the process and by the *almost universal acquiescence* of the public in the validity of the patent in many cases after years of litigation.

The final solving of the problem of the flotation of the porphyry copper ores, the world's greatest source of copper, by the process of the patent in suit, makes it and makes this case almost unique in the history of patent law in this country.

This Court said in *Eibel Process Co.* v. *Minn. & Ont. Paper Co.*, 261 U. S. 45, 54, of the far less important contribution to society:

> "Our conclusion is confirmed * * * by the circumstances, uncontroverted, that the owners of these fastest machines at once, upon Eibel's publication of his discovery, adopted his pitch and increased their product. * * * The fact that the Eibel pitch has thus been generally adopted in the paper making business, and that the daily product in paper making has thus been increased at least twenty per cent over that which had been achieved before Eibel, is very weighty evidence to

sustain the presumption from his patent that what he discovered and invented was new and useful."

In *Minerals Separation, Ltd.* v. *Hyde,* 242 U. S. 261, 270, this Court said of the process of patent No. 835,120 (and the process of the patent in suit is a younger and a greater brother):

> "that the process in suit was promptly considered by the patentees as an original and important discovery, * * * it promptly came into extensive use * * * it has largely replaced all earlier processes. This, of itself, is persuasive evidence of that invention which it is the purpose of the patent laws to reward and protect."

In *Benjamin Co.* v. *Northwestern Co.,* 251 Fed. 288, 294, Judge Hough said for the Circuit Court of Appeals of the Second Circuit:

> "Prompt and extensive use plus displacement of earlier devices is 'of itself' persuasive evidence of invention (*Minerals Separation* v. *Hyde,* 242 U. S. at 270, 37 Sup. Ct. 82, 61 L. Ed. 286), a form of statement stronger, we think, than has before fallen from that court on this subject."

The Circuit Court of Appeals for the First Circuit in the instant case in upholding the defense of anticipation on surmise and conjecture and disputed theory and discredited speculation, and really, with all respect, in fundamental ignorance of the subject matter, failed to apply the rule of law that *the burden is on a defendant to prove an affirmative defense.*

In *Cantrell* v. *Wallick,* 117 U. S. 689, this Court said, in speaking of the defenses of prior use and want of novelty:

> "The burden of proof is upon the defendants to establish this defense. For the grant of letters patent is *prima facie* evidence that the patentee is the first inventor of the device described in the letters patent and of its novelty. *Smith* v. *Goodyear Dental Vulcanite Co.,* 93 U. S. 486; *Lehnbeuter* v. *Holthaus,* 105 U. S. 94. Not only is the burden of proof to make good this defense upon the party setting it up, but it has been held that

> 'every reasonable doubt should be resolved against him.' *Coffin* v. *Ogden*, 18 Wall. 120, 124; *Washburn* v. *Gould*, 2 Story, 122, 142."

In *Smith* v. *Goodyear Dental Vulcanite Co.*, 93 U. S. 486, this Court said:

> "The patent itself is *prima facie* evidence that the patentee was the first inventor; at least, it casts upon him who denies it the burden of sustaining his denial by proof."

The Circuit Court of Appeals for the First Circuit in the instant case also failed to apply *the rule as to anticipation by a prior document* that the disclosure contained in the prior document must be full and clear and must certainly disclose the very invention in issue.

In *Seymour* v. *Osborne*, 11 Wall. 516, 555, Mr. Justice Clifford said:

> "Mere vague and general representations will not support such a defense, as the knowledge supposed to be derived from the publication must be sufficient to enable those skilled in the art or science to understand the nature and operation of the invention, and to carry it into practical use."

Nobody skilled in the art derived at the time of its issue, or afterward, from patent No. 835,120 knowledge sufficient to enable him to understand the nature and operation of the invention of the patent in suit No. 962,678 and to carry the process of the patent in suit into practical use.

In *Cohn* v. *Corset*, 93 U. S. 366, 370, Mr. Justice Strong said:

> "It must be admitted that, unless the earlier printed and published description does exhibit the later patented invention in such a full and intelligible manner as to enable persons skilled in the art to which the invention is related to comprehend it without assistance from the patent, or to make it, or repeat the process claimed, it is insufficient to invalidate the patent."

This rule was affirmed in *Downton* v. *Yeager Milling Co.*, 108 U. S. 466, 471, and in *Eames* v. *Andrews*, 122 U. S. 66. See also *Railroad Co.* v. *Turrill*, 4 Otto 695, 704.

Patents are to be liberally dealt with on the question of validity under the rule *ut res magis valeat quam pereat.*

In *Turrill* v. *R. R. Co.*, 68 U. S. 491, 510, 17 L. Ed. 668, 672, Mr. Justice Clifford said:

> "Patents for inventions are not to be treated as mere monopolies and, therefore, odious in the eyes of the law; but they are to receive a liberal construction, and under the fair application of the rule, *ut res magis valeat quam pereat*, are, if practicable, to be so interpreted as to uphold and not to destroy the right of the inventor."

In *Rubber Co.* v. *Goodyear*, 9 Wall. 788, 795, Mr. Justice Swayne said:

> "But liberality, rather than strictness, should prevail where the fate of the patent is involved, and the question to be decided is whether the inventor shall hold or lose the fruits of his genius and his labors."

In the instant case and considering the interval in the art from the date of issue of patent No. 835,120 in 1906 to the time of the making of the invention of the patent in suit, No. 962,678 in or about 1909, the evidence is clear and undisputed that *the men skilled in the art did not then find in the disclosure of patent No. 835,120 the invention of patent No. 962,678.* Sulman, Picard, Higgins, Chapman, Greenway and others were the most expert and the most experienced in this art at that time. They were connected with such commercial applications of the process of patent No. 835,120 as occurred during that period and some of them toward the end of that period, under pressure of litigation in England on the Elmore patents for the use of an acidified pulp in an oil flotation process, were eagerly seeking a froth-flotation process *that would avoid the use of oil.* The ultimate outcome of that litigation in 1910 in the House of

Lords and in the Privy Council in 1914 freed the oil process of patent No. 835,120 from the domination of the Elmore patents in that regard because of the microscopic quantity of oil employed, but during the period in question that outcome could not be confidently predicted and the threat against the entire enterprise of plaintiff's predecessor in business was very great. If the present conclusion of the Circuit Court of Appeals for the First Circuit in the instant case that the invention of patent No. 962,678 stood all the time disclosed in patent No. 835,120, that eager effort of the experts at that time to avoid the Elmore patents was all wasted effort. But, as this Court has said, on such a matter the judgment of those expert in the art is the safest guide. What the Circuit Court of Appeals for the First Circuit found in patent No. 835,120 in January, 1929, none of the experts in the art found or could find in it during the period in question.

As was said by this Court in *Potts* v. *Creager*, 155 U. S. 597, 608, in a somewhat analogous situation,

> "*The practiced eye of an ordinary mechanic* may be safely trusted to see what ought to be apparent to everyone."

As the late Judge Hough said for the Circuit Court of Appeals for the Second Circuit in *Kurtz* v. *Belle Hat Lining Co.*, 280 Fed. 277,282, on the related question of obviousness as against invention, the Court should not substitute its "own experience" for "the eyes of the hat lining trade."

See this Court to the same effect in *Carnegie* v. *Cambria Iron Works*, 185 U. S. 403. As Judge Learned Hand said for the Circuit Court of Appeals for the Second Circuit in *Dubilier Condenser* v. *New York Co.*, 20 Fed. (2d) 723,

> "In all inventions *the safest test* is the condition of the art before and after the putative invention appears. At least that is an immeasurably safer test, when available, than any *a priori* conclusion as to what is or is not an obvious step. To the last we should not resort, except in cases of absolute necessity."

The revolutionary advent in the commercial froth-flotation art of the invention of the patent in suit, No. 962,678, did not occur when the now alleged disclosure of that process in patent No. 835,120 occurred. If it had that fact would have tended strongly to confirm the conclusion of the Circuit Court of Appeals for the First Circuit in the instant case. The fact that it did not occur to any one during the interval between 1906 and 1909, though such a process omitting oil was eagerly sought, tends strongly to refute that conclusion.

We submit that it is clear that the patent in suit, No. 962,678, is not anticipated by patent No. 835,120 and that the District Court and the Circuit Court of Appeals for the Third Circuit in the *Miami* case and the District Court in the instant case were right in so holding and that the Circuit Court of Appeals for the First Circuit in the instant case (or a majority of that court) erred in holding to the contrary.

INFRINGEMENT.

The trial Judge very fully considered the question of infringement and held that the defendant's operations infringed claims 1 and 2 of the patent in suit. Demonstrations were made during the trial including the showing in small mill-size apparatus installed in Boston, of the operation of the process of the patent in suit as carried on by the defendant. Offers were made during the argument in the Circuit Court of Appeals to repeat these demonstrations, but were declined. The Circuit Court of Appeals did not see any demonstrations. Its opinion does not discuss the question of infringement. Therefore the findings of the trial Judge as to infringement stand unassailed.

We, therefore, show only the facts as to defendant's operations, from which infringement is manifest.

The facts as to infringement fully appear by stipulation (R., Vol. I, pp. 103-106). The defendant by water-concentration operations prepared a product known as the drag-classifier overflow, containing only about 2.2% of copper (R., Vol. I, p. 105) with the ore finely ground so that it would all pass through a 60-mesh screen (p. 104) and carried in water with a relation of

water to solids of about 5 to 1. This pulp also carried a small amount of lime which was added with the ore and water to the feed to the first ball mill (p. 103). This pulp was flowed into Callow pneumatic cells, and into these cells was also flowed a solution of alpha-naphthylamine (X-cake) of the strength of one part of X-cake to 1000 parts of water (p. 105). The proportion of X-cake to ore was a little less than half a pound of X-cake to a ton of ore (which as we shall show, makes less than one part of X-cake to 20,000 parts of water in the pulp). Air was blown into these pneumatic cells through the porous inclined bottoms thereof and by it the pulp was vigorously agitated, a great number of minute air bubbles formed, the ore particles were brought into contact with the air bubbles, and the result was that a froth carrying the metallic sulphide particles of the ore floated upon the surface of the pulp and overflowed, carrying with it the sulphide particles in a concentrate, in this instance called a rougher concentrate. The rougher concentrates produced in two large, rougher pneumatic cells were flowed into a smaller cleaner pneumatic cell, where the operation above described was repeated and the froth overflowed as a finished product. The Callow pneumatic cells or flotation cells above referred to, of which there were 4 roughers and 2 cleaners, were known as the upper flotation cells. There was then some treatment by water or gravity concentration over Wilfley shaking tables of the depleted pulp flowing out of the rougher pneumatic cells, which recovered a small amount of the coarse material as a finished concentrate and passed on their tailings to the lower flotation cells. It may be noted that the tailings of the upper cleaner cells and the middlings of the Wilfley tables were sent back to the circuit so as to be elevated and again put through the drag classifier.

The lower flotation cells comprised 2 rougher cells which divided between them the tailings of the Wilfley tables and sent their own tailings to waste, i.e., to the ponds in which the solids were allowed to settle so that the water could be pumped back and used over again in the mill, while the overflow froths from these rougher cells was pumped to a single cleaner cell the overflow froth of which was a finished concentrate and the tailings

of which were returned by a pump to the head of the lower flotation cells.

Thus the defendant carried on in nine Callow pneumatic cells the operations of agitating a pulp of powdered ore and water, the water containing in solution a small quantity of a mineral-frothing agent, and of agitating this mixture to form a froth and separating the froth, as pointed out in claim 1, and the mineral-frothing agent in solution was an organic mineral-frothing agent, as additionally required by claim 2.

The operation may be described in the language of the patent in suit. "The crushed ore" in these pneumatic cells "is mixed with water containing in solution a small percentage of a mineral-frothing agent," "the mixture is thoroughly agitated," "the gas [air] is effectively introduced into the mixture, and the ore particles come in contact with the gas [air] and the result is that metallic sulphide particles float to the surface in the form of a froth," which is "separated by" overflowing.

As suggested in the specification the tailings are retreated by the same process without the addition of fresh quantities of the mineral-frothing agent, i.e., the tailings of the upper flotation roughers, after having some coarse material taken out of them in passing over the Wilfley tables, are retreated in the lower flotation roughers and the tailings of the latter go to waste.

The solubility of alpha-naphthylamine is .17 parts in 100 parts of water, or 1.7 parts in 1000 parts of water (17 pounds in 10,000 pounds of water). This figure was given by Mr. Wilding (R., Vol. I, p. 163, RDQs325-328) and his testimony giving further authorities (RDQ327) was interrupted by Mr. Davis, who said "That figure satisfies us." Defendant's solution of alpha-naphthylamine which was fed to its ore pulp contained only 1 part of alpha-naphthylamine to 1000 parts of water (Stipulation, R., Vol. I, p. 105, 3rd paragraph) so that there was complete solution. This ore pulp was the overflow from the drag classifier and contained between 16% and 17% of solids (Stipulation, R., Vol. I, p. 105, last paragraph) and was therefore 83% to 84% water, and the pulp approximately a 5 to 1 pulp. Therefore for every ton of ore there were 5 tons, or 10,000 pounds of water, which would have dissolved 17 pounds of

alpha-naphthylamine, whereas the amount used was 0.
pounds, or less than one-half a pound per ton of ore, which w
obviously completely dissolved.

It is submitted that the decree of the Circuit Court of A
peals should be reversed, and the decree of the District Co
affirmed.

Very respectfully,

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WM. HOUSTON KENYON,
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Dated, New York, N. Y., November 11, 1929.

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Supreme Court of the United States

October Term, 1929

No. 71

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner-Plaintiff,

—vs.—

MAGMA COPPER COMPANY,
Respondent-Defendant.

REPLY BRIEF FOR PETITIONER-PLAINTIFF

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Supreme Court of the United States

OCTOBER TERM 1929.

No. 71.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner-Plaintiff,
—vs.—
MAGMA COPPER COMPANY,
Respondent-Defendant.

REPLY BRIEF FOR PETITIONER-PLAINTIFF.

First Defense: that the Patent in Suit is anticipated by Patent No. 835,120.

Petitioner's Brief* argues this matter so fully that we shall here only point out some of the errors in Respondent's Brief.

The major error is its use of the phrase "preferential affinity for metalliferous matter" in a wholly wrong sense, unwarranted and false. This error is the very crux and basis of its argument as to anticipation.

The phrase appears in patent No. 835,120 as defining the broad disclosure therein of the oils, etc. of that patent. As this Court said in the *Butte* case in construing that patent (250 U. S. 349):

> "the only disclosure as to the kind * * * of oil which the patentees made to the public as necessary to the practising of their process is that it must be an oil or oily substance, or oily liquid having a 'preferential affinity for metalliferous matter,'"

*References to the "Brief for Petitioner-Plaintiff" will be entitled P. B., and references to the "Brief for Respondent-Defendant" will be entitled R. B. Unless otherwise indicated, bracketted portions and italicizing in quotations will be ours.

The meaning in which this phrase is used appears from other parts of the opinions of this Court in the *Hyde* and *Butte* cases. For example in the *Hyde* case, after quoting the phrase in full from the specification of patent No. 835,120, and referring to the use of oils in the prior art, this Court said (242 U. S. 264):

> "it was well-known that oil and oily substances had a *selective affinity or attraction for, and would unite mechanically with,* the minute particles of metal and metallic compounds found in crushed or powdered ores, but would not so unite with the quartz, or rocky non-metallic material called 'gangue.'"

Again in the *Hyde* case this Court quoted from Lord Atkinson of the House of Lords in *Minerals Separation, Ltd.* v. *British Ore Concentration Syndicate, Ltd.*, as follows (242 U. S. 269):

> "And Lord Atkinson said: 'In their process this *mysterious affinity* of oil for the metallic particles of the ore is availed of, yet the oil is used in such relatively infinitesimal quantities that the metallic particles *are only coated with a thin film of it,* * * * air bubbles, which, * * * envelop or become attached to, the *thinly oiled metallic particles,* and raise them to the surface * * *.'"

And in describing the process of patent No. 835,120, this Court also said in the *Hyde* case (242 U. S. 267):

> "which air, in bubbles, attached itself to the mineral particles, *slightly coated as they were* with what was necessarily an infinitesimal amount of oil, and floated them to the surface."

Respondent's Brief refuses to accept this definition of the phrase "preferential affinity for metalliferous matter" or to use it with this meaning, but on the contrary uses the phrase with another and a different meaning that is born of the exigencies of its case here and that serves the purposes of its argument of anticipation. Thus Respondent's Brief, referring to the decisions of this Court in the *Hyde* case and the *Butte* case, says (R. B., pp. 46, 47):

> "The court, as we read the opinion, was only concerned to know whether or not the particular oils there in question would display preferential affinity for the metalliferous matter *by the practical test of bringing the metalliferous matter to the surface of the pulp.*"

Moreover the meaning in which Respondent's Brief everywhere uses the phrase in question is disclosed in its statement, made as to amyl acetate (R. B., p. 29):

> "it forms a mineral-bearing froth, *thereby* displaying its preferential affinity for metalliferous matter over gangue."

In other words, Respondent's Brief defines the phrase "preferential affinity for metalliferous matter" as synonymous with "forming a mineral-bearing froth."

This defines the phrase by the *ultimate result* of the operation (i. e., the mineral-bearing froth) and disregards the *function* or *means* by which that result is reached (i. e., the preferential coating of the metalliferous matter) and the *quality of the agent* that leads to that preferential coating (i. e., its preferential affinity for metalliferous matter) and the accompanying quality of insolubility of the agent that is absolutely essential to the formation and persistence of any coating whatever.

This error of definition is an argumentative artifice which improperly expands the disclosure of patent No. 835,120 and endeavors thereby to bridge the gulf between the two patents and indeed begs the whole question of anticipation, and at the same time it seeks to avoid and destroy the effect of the decision of this Court as to the disclosure of patent No. 835,120.

That the phrase in question is used in patent No. 835,120 in the meaning that we give and not in the meaning given in Respondent's Brief, is manifest from the repeated references in specification and in claims to the preferential coating of the mineral particles and to the lifting of the coated particles by the air bubbles into a froth (P. B., p. 12, foot note).

That the phrase in question was used by this Court in the *Hyde* and *Butte* opinions with the meaning that we give and

not with the meaning given in Respondent's Brief, appears from the repeated references in those opinions to the coating of the mineral particles and is sufficiently indicated by the quotations therefrom above given (See also P. B., pp. 4-7).

Obviously to the end that the oil or oily substance or oily liquid of patent No. 835,120 may exercise preferential affinity in the pulp and preferentially coat (unite mechanically with) the metalliferous mineral particles, the substance must be insoluble in the water of the pulp. As the Circuit Court of Appeals for the Third Circuit said in the *Miami* case (244 Fed. at 773):

> "The difference between the two patents may be shortly stated to be this: The first process rests upon the use in very small quantity of an oily substance that does not dissolve in water, coupled * * *. The second process does not employ oil, or an undissolvable substance; on the contrary, the 'mineral frothing agent' must be in solution, and *ex vi termini* must therefore be dissolvable."

To support its false position in this matter, Respondent's Brief builds up a tissue of errors as to facts and gross distortions as to the meaning of technical terms in the art.

Faced with the repeated references in patent No. 835,120, and its claims, to the *oil-coating* of the metal particles, and with the characterization by this Court of the selective affinity or attraction as *uniting the oil mechanically with the minute particles of metal,* Respondent invokes the theory of *adsorption* and, contrary to the proved facts, asserts that the soluble mineral-frothing agents of the patent in suit, No. 962,678, unite mechanically with the minute particles of the metal and coat them, just as do the oils and oily substances of 835,120. This theory was completely discredited in the proofs and is sufficiently discussed in Petitioner's Brief at pages 64-70.

That the oils or oily substances of 835,120 must be *insoluble* in the water of the pulp in order to exercise preferential affinity for, and unite mechanically with, the minute particles of metal, is obvious. Nevertheless Respondent's Brief expends much ef-

fort to show that insolubility was not disclosed in that patent because the word insoluble or an equivalent word does not there appear. It says (R. B., p. 35):

> "The word 'insoluble' does not occur either in the specification or in the claims of patent 835,120. Nor is there any equivalent word therein, * * *."

Again (R. B., p. 34):

> "Neither the word 'insoluble' nor any similar word is found in patent 835,120."

Why use the word "insoluble," or its equivalent, when speaking of oils or oily substances? It would be just as unnecessary as adding the word "sweet" to sugar in order to define what was meant. The insolubility of oil and oily substances was and is well known to all.

The first dictionary we turn to, namely, "The Practical Standard Dictionary. Funk & Wagnalls. 1930" gives as the first definition of "Oil" as a noun:

> "1. A greasy or unctuous liquid, of vegetable, animal or mineral origin, insoluble in water but sometimes soluble in alcohol, and always in ether."

A study of the concentration of ore by the use of oil or oily substances from the time of Herodotus down to the time of patent No. 835,120 discloses that it is the insolubility of oil and oily substances that enables it to exercise its preferential affinity for metalliferous matter over gangue in a watery pulp. Without insolubility, preferential affinity for metalliferous matter would be vain, and mechanical uniting with the minute particles of metal to coat them would be impossible.

Herodotus tells of virgins on a certain island smearing pitch on feathers and rubbing the feathers in sand at the bottom of the lake whereby particles of gold from the sand stuck to the pitch and were thus collected. If the pitch had been soluble in the water of the lake it would have been washed off by the

water and the gold would not have stuck to the feathers. This is equally true of all efforts to recover metalliferous matter from ore by the preferential affinity of oils and oily substances for metalliferous matter. In each and every instance insolubility has been a prerequisite and a *sine qua non* and has been sought as such and this has gone without saying. When it is considered, therefore, that the patentees of 835,120 were addressing men skilled in the art, it will be appreciated that the addition of the word "insoluble" or its equivalent was quite unnecessary and would have been quite redundant. The word "immiscible" equivalent to "insoluble" is used in the patent in suit, No. 962,678, because the novel and astonishing idea there disclosed is the contrasted solubility of the mineral-frothing agent.

It was proved at the trial that in the process of patent No. 835,120 the active principle in producing the mineral-bearing froth is found in the coating of oil or oily substance that was mechanically united with the minute particles of metal, whereas in the case of the process of the patent in suit the active principle is found in the water of the pulp, the agent in solution modifying the water in such a way as to produce a mineral froth bearing uncoated mineral particles (P. B., pp. 9-11).

Faced with this situation, Respondent propounds the theory which is stated on page 58 of its Brief:

> "The fact is also known that all substances which produce froth contain a soluble constituent.
>
> "The modern theory is that the froth formation is dependent upon the modification of the water by the soluble constituent, * * *."

There is absolutely no justification in the record for either of these statements insofar as concerns the oils and oily substances of patent No. 835,120. The evidence is exactly to the contrary. Respondent's experts started out to prove that oleic acid, the agent that is specifically disclosed in patent No. 835,120, was partly soluble (and the Circuit Court of Appeals for the First Circuit erroneously ascribed its mineral-froth

forming power to this solubility[1]) but on cross examination the effort broke down, for it appeared from the testimony of defendant's experts that the solubility of oleic acid was of the same order as that of window glass and that "glass certainly would not be considered soluble for the purposes of flotation" (P. B., pp. 70-76).

To establish the partial solubility of oleic acid and that the alleged soluble part formed the froth, was so vital to Respondent's contention of anticipation of the patent in suit by the disclosure of patent No. 835,120 that it seems inexplicable that its experts did not demonstrate in Court that a solution of oleic acid would produce a mineral-bearing froth. They had ample opportunity to do so. But no such demonstration was made in Court, nor is there any evidence in the case that their experts made any such demonstration at any time. Plaintiff proved the contrary (see P. B., pp. 53, 54).

Curiously enough Respondent's Brief three times asserts or implies (pp. 36, 40, 43) that the burden of proof is upon the plaintiff to establish the fact that the patent in suit, No. 962,678 is not anticipated by patent No. 835,120. The burden of proof is quite the other way. It rests on respondent. The respondent alleged in its answer that patent No. 835,120 anticipated the patent in suit and the burden of proving that defense in all its branches was upon the respondent. On both the propositions incidental to this defense that are advanced by respondent, namely, that the soluble substances of 962,678 coat the mineral particles just as oleic acid, the typical agent of 835,120 does, and that a part of oleic acid is soluble in the pulp, just as the reagents of 962,678 are, the burden is on respondent.

As to the asserted inclusion in the disclosure of patent No. 835,120 of other specific substances than oils and oily liquids, Respondent's Brief bases arguments on words and names as contra-distinguished from the substance of things.

Thus the term "fatty acid" in chemical classification is applied to all the members of a certain series of compounds which, in their chemical constitution, are similar, but which differ

[1]R., Vol. I, p. 651. See also P. B., p. 70, where the pertinent part of the opinion is quoted and commented upon.

widely in their physical characteristics, only some of them being of a fatty or oily nature like oleic acid, such as would adapt them to display selective affinity or attraction for, and to mechanically unite under water with, and so coat, metalliferous matter.

Respondent, however, by following this chemical classification without regard to the physical characteristics, and also by following commercial nomenclature regardless of either chemical composition or physical characteristics, misled the Court below into believing that specific mineral-frothing agents that are wholly dissolved in the water of the pulp and so could not have, and usefully exercise, the preferential affinity for metalliferous matter of patent 835,120, are nevertheless oils of that patent.

One of the substances which acts as mineral-frothing agent in solution and is specifically named in the patent in suit, valerianic acid, is classified by Respondent as an oil of patent No. 835,120 because it is chemically a fatty acid, although it is not physically an oil or an oily liquid and it does not have the physical characteristics of oils and is admittedly completely soluble in water in the proportions used in flotation. Professor Taggart includes this substance with acetic acid as a fatty acid of the prior art, although even he admits that valerianic acid and acetic acid would not normally be referred to as oils (R., Vol. I, pp. 205, 206, Q26). Acetic acid is familiar as ordinary table vinegar. Although it is classified chemically as a fatty acid, it is needless to say that in its physical characteristics it is not an oil or oily liquid. It acts as a mineral-frothing agent in solution. It is completely soluble in the water of the pulp and does not have selective affinity or attraction for, nor can it mechanically unite under water with, the metalliferous matter as a coating, for it goes wholly into the water of the pulp. Vinegar is physically the antithesis of oil in every respect.

Another substance acting as a mineral-frothing agent in solution is ordinary table salt, sodium chloride. Obviously when

completely dissolved in water it cannot have preferential affinity for, or preferentially coat, the metalliferous mineral particles. Yet, according to the definition of Respondent's Brief, appearing at page 29 therein, ordinary table salt

> "forms a mineral-bearing froth, thereby displaying its preferential affinity for metalliferous matter over gangue."

What could be more destructive of this Court's definition of the oils of the patent No. 835,120 than such an interpretation of that definition? It does not require any particular skill in the metallurgical art to know that salt water and dilute vinegar are not oils or oily substances and do not have the physical characteristics of oils or oily substances and do not have the preferential affinity for metalliferous matter that oils or oily substances have.

An example of misleading commercial nomenclature which Respondent's Brief attempts to turn to its advantage is the name commercially given to amyl acetate. Amyl acetate is a mineral-frothing agent in solution of the patent in suit No. 962,678. It is commercially known as banana oil. It is a colorless liquid not oily at all and gives a clear and brilliant solution. Yet it is claimed to be an oil of patent No. 835,120 because commercially called an oil, as well as because in the process of 962,678 it will produce a mineral-bearing froth.

By parity of reasoning, as we said in Petitioner's Brief (p. 110), sulphuric acid, commercially known as oil of vitriol, would be an oil of patent No. 835,120, although it is disclosed in that patent as a gangue-corrective used with the oily substance, oleic acid, and not as a mineral-frothing agent.

The above are merely examples of the many misleading statements of Respondent's Brief. Similar statements made in the briefs and argument to the Court immediately below unquestionably misled that Court. Petitioner's Brief sufficiently discusses the errors made by the Court immediately below in this connection (P. B., pp. 76-80, 109-114).

Respondent's new and false definition of "preferential affinity for metalliferous matter" as "producing a mineral-bearing froth" is really a grotesque anachronism. It ignores the well known specific quality of oil, when agitated in an ore pulp, of having a preferential affinity for metalliferous matter, a quality well known in many processes, as this Court has said, ever since the days of Haynes, Everson and others, and instead defines that quality by a result peculiar to a particular process and first made known to the world, as this Court has also said, by patent No. 835,120.

What did the phrase "preferential affinity for metalliferous matter" mean, we might ask Respondent, before there was any mineral-bearing froth?

What did it mean in Haynes, in Everson? What did it mean in the Elmore bulk-oil process? What did it mean in the Cattermole granulation metal-sinking process? What did it mean to the stickiness of coating required for the granulation step in the last-named process? *

---

* *The Cattermole granulation process* proceeded by coating the metalliferous particles in the pulp (particles many of them as fine as dust) with oil until the coated particles acquired the *quality of stickiness* with reference to each other and *stuck together* when they collided in the agitated pulp (in a way like a snow ball rolled in sticky snow) and eventually thereby formed larger agglomerates or granules such as would sink in an up-current of the pulp sufficiently rapid to carry upward the uncoated and ungranulated and so still exceedingly small and fine particles of gangue; and thus the granules were separated from the gangue in a metal-sinking operation. It required from 36 to 72 lbs. of oil to the ton of ore to achieve the required *quality of stickiness* in this oil coating on the mineral particles. Nothing could be clearer than that this granulation process involved and required the mechanical uniting of the oil with the mineral particles in preference to the gangue in the form of a coating thick enough to acquire the desired quality of stickiness. In this process it would be absurd to say that the preferential affinity of the oil for the metalliferous matter meant its capacity to bring up a mineral-bearing froth. Clearly Respondent's definition does not apply. On the contrary our definition exactly applies.

Now this is crucial because it was out of precisely that granulation process that the process of 835,120 was born by an exploration of how much that 36 lbs. of oil could be reduced—how thin that coating could be made. And as the exploration proceeded and the amount of oil was reduced, without any other change, the phenomenon of granulation gradually disappeared and a then altogether new phenomenon took its place, the phenomenon of a mineral-bearing froth, which phenomenon was accounted for then by its discoverers and inventors and by their patent No. 835,120 and has been accounted for ever since by everybody (outside of this litigation) as due to the thinness of the oil coating on the metalliferous matter and the tendency of that so thinly-coated matter to rise to the surface in the form of froth, when caught by the air-bubbles in the pulp and brought up by the lifting force of those air bubbles.

Respondent by its new and false definition of "preferential affinity" in effect credits patent No. 835,120 with being a patent broadly for a result, a mineral-bearing froth however obtained, although this Court explicitly held that that patent was not for a result (250 U. S. 349). There (the *Butte* case) this Court said of 835,120:

> "The patentees discovered the described process for producing the result or effect, the metal-bearing froth, but they did not invent that result or froth,—their patent is on the process; it is not and cannot be on the result; and the scope of their right is limited to the means they have devised and described as constituting the process."

The repeated misuse of the phrase "preferential affinity for metalliferous matter" in Respondent's Brief is so vital a matter that it has received first attention.

The three criticisms found on pages 3 to 7 of Respondent's Brief under the heading "Plaintiff's Statement of the Case is Erroneous," spring wholly from Respondent's misuse of the phrase "preferential affinity for metalliferous matter over gangue" and fall when that error is corrected.

In fact, the correction of that error sweeps away the whole fabric of Respondent's argument as to the First Defense covering pages 7 to 58 of its Brief.

Another fundamental error of Respondent's argument is the failure to recognize that the invention claimed in the patent in suit is a process. It is conceded that this Court in the *Hyde* case and the *Butte* case "made clear that the discovery of patent No. 835,120 was a *process* discovery" (R. B., p. 18), but the process of the patent here in suit, a much more astonishing process discovery—a complete departure from the prior art—is treated in Respondent's Brief as not a process invention at all. Indeed in the discussion of the invention in issue and of the prior art, *process is disregarded and agents used are alone considered.* For example, Point I (R. B., p. 10), is as follows:

> "The subject-matter claimed in patent 962,678 is the use of a 'soluble' mineral-frothing agent in the agitation froth process of plaintiff's earlier patent 835,120. There is no other difference between them."

This ignores the fact that the subject-matter claimed is a new process and ignores the fact proved in the evidence that this process differs essentially from the process of patent No. 835,120. The two processes are compared in Petitioner's Brief (pp. 39-46). Nothing appears in Respondent's Brief making it necessary to alter that comparison. Respondent's argument on this point (R. B., pp. 10, 11) merely quotes the first of these differences and assumes that the other differences, although established by the evidence, do not exist.

Moreover, substances are listed in an appendix to Respondent's Brief (pp. 91-95) indiscriminately and without regard to process or function or result.

The errors of Respondent's Brief of perhaps next importance are the charge that the present assertions of Petitioner's counsel as to the utility of the invention here in suit are (R. B., p. 52)

> "contradictory of the plain facts and of what the same counsel urged upon this Court and the other courts in the litigation on Patent 835,120"

followed by the assertion that

> "In this way counsel seek to escape the troublesome fact, proved in this record, that the soluble mineral-frothing agents named in Patent 962,678 have never had any commercial use."

We will first consider the charge and then the assertion.

The charge is entirely without foundation.

In the suit of *Minerals Separation* v. *Hyde* (commenced in 1911) the sole issue as to infringement was the use by defendant on a zinc ore of a froth-flotation process employing oleic acid as the frothing agent. In that suit the Australian oper-

ations with zinc ores were fully set forth and the financial returns of those operations were proved. Operations in Sweden, Chili and Cuba with the process of patent 835,120 were also proved and the sum total of all these operations was large, so much so that Judge Bourquin said of the process (*Minerals Separation* v. *Hyde*, 207 Fed. 959):

> "Its successful operations, practically from discovery, have recovered, and largely from waste and tailings, values aggregating near $9,000,000, and at a profit of near $4,000,000 to the patent owner and its licensees."

In the suit of *Minerals Separation* v. *Butte & Superior Mining Co.*, the infringement was at the same mine and with the same ore. It developed at the trial (April and May, 1917), however, that operations with oleic acid had been followed by operations with other substances, including one—called pine oil—which had constituents that acted as mineral-frothing agents in solution as well as constituents which acted as insoluble mineral-frothing agents. Accordingly a motion was made to include in the suit the patent here in suit, No. 962,678, but Judge Bourquin denied the motion and so the suit proceeded on patent No. 835,120 alone. Patent No. 962,678 was, however, put in evidence and the fact that its process was to some extent used by the defendant there when it used pine oil was repeatedly referred to in briefs and arguments in behalf of the plaintiff. There was, however, no evidence in that suit as to what proportion or quantum of its constituents went into solution and what proportion or quantum of its constituents was insoluble.*

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* The typical example referred to by this Court in the *Butte & Superior* suit (250 U. S. 342) of the later operations of the defendant there, was one wherein a mixture of kerosene, fuel oil and pine oil was used, and wherein the total amount of oil was 1½% (30 pounds to the ton of ore), and the two first mentioned constituents (insoluble petroleum products) were present in excess of 1%. These later operations were held by this Court not to be an infringement of patent No. 835,120. This Court in that case discussed only the question as to whether or not the insoluble petroleum products used were oils of patent No. 835,120.

In the present suit there is definite evidence as to the proportions of soluble and insoluble constituents in different pine oils. Professor Taggart states his determination of different specimens as giving solubilities of 78.8%, 69.2% and 40.4% (R., Vol. I, pp. 219, 220, Q58) and also testifies that pine oil is a variable "mixture of a lot of different chemical compounds."

In the suit of *Minerals Separation* v. *Miami Copper Company* (April and May, 1915), both the patents here in suit were involved, and the important fact that the use of the process of the patent in suit was essential to the froth-flotation concentration of porphyry copper ores was quite fully brought out. The issue as to infringement was the conjoint use of the processes of patents Nos. 835,120 and 962,678, and also a third patent not here involved. The defendant's ore there was a porphyry copper ore.

As we have carefully pointed out it was not until after the invention and patenting of the process here in suit and the beginning of the use of that process, either alone or conjointly with the process of No. 835,120, that porphyry ores were found to be amenable to froth-flotation concentration. We said in Petitioner's Brief at page 52:

> "For the flotation of porphyry ores the process of patent No. 835,120 is, in the majority of cases, greatly advantageous, but the process of the patent in suit No. 962,678, is in all cases absolutely necessary."

The whole story of commercial operations of the two processes is set forth in the record here and is briefly and accurately summed up in Petitioner's Brief, pages 46-52.

As to the above quoted assertion of Respondent's Brief that the soluble mineral-frothing agents named in the patent in suit have never had any commercial use, the fact is quite the contrary. Phenol and its homologues, including cresol, have been extensively used, largely in the form of complex substances containing them. They appear among the agents used by 54 of the 80 licensees of the plaintiff whose reagents are proved (R., Vol. II, pp. 695-712) representing a total tonnage of more than 90,000,000 tons of ore treated (pp. 721-723). Three of these licensees used cresol. The others used creosotes and tars selected and manufactured to contain substantial quantities of phenol and its homologues. It may be noted here that there is no evidence of the disclosure or use of phenol or its homologues or any substances containing them in a froth-flotation

process prior to the phenol tests of Stevens on December 8, 1908, in the work of reducing to practice the present invention.*

In the Brief for Respondent in Opposition to Petition for Writ of Certiorari (on file in this Court), on page 5, appears the following foot-note:

> "In 1923, when the instant case was on trial, the yearly aggregate of licensed tonnage was 169,041,149 tons (Pltf.'s Exs. 18 and 19; R., II, 83-93)." [Present record, R., Vol. II, pp. 713-723.]

This statement is erroneous. The figure is neither the yearly annual tonnage nor the total tonnage. It is the total licensed tonnage of ore treated in the United States up to June, 1923, insofar as the returns of licensees are in figures of tons of ore treated. To this is to be added 1,084,313 tons of concentrates produced where the returns were in that form, and to it is to be further added 38,085,664 pounds of lead, zinc and copper recovered and 7,678,437 ounces of gold and silver recovered, where the returns are in weight of metals recovered (R., Vol. II, p. 725). Moreover the record does not show the extensive use of the process in the rest of the world, nor the fabulous profits of the mine owners, nor the amounts paid as royalties.

In that Brief (p. 5) attention is also called to the fact that the Petitioner has enjoyed the benefit of the favorable decision of the Circuit Court of Appeals for the Third Circuit, from its date May 24, 1917, to the expiration of the patent in suit on

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* See *infra* pp. 21, 22. As to the prior processes on which Respondent relies as disclosing coal tar and wood tar products, etc. (R. B., pp. 52-53 pp. 13-17; Appendix, pp. 91-95) the testimony of Mr. Higgins showing how totally different these processes are from that in suit, is here cited with references to Vol. I of the Record.

Haynes, pp. 424-425, Qs. 1-5;
Bessel, pp. 425-427, Qs. 6-24;
Everson, pp. 427-430, Qs. 25-45;
Sutton, p. 431, Qs. 46-48;
Robson and Crowder, p. 431, Qs. 49, 50;
Froment, pp. 431-435, Qs. 51-85;
Elmore 703.905, p. 435, Qs. 86-89;
Cattermole, pp. 437, 438, Qs. 105-109;
Cattermole, Sulman & Picard, pp. 438-442, Qs. 110-152;
Sulman & Picard, pp. 442-443, Qs. 153-161.

June 28, 1927, and that the great bulk of the ore treated in this country was under license, and it is said (*ib.*):

> "The validity of the patent is, therefore, a question that interests only the petitioner, the respondent and the National Lead Company"

thus conceding acquiescence in the patent in suit and payment of royalty up to the date of expiration of the patent by almost all of the tremendous mining industry.

A parallel statement of the facts as to use at the two periods in question (i. e. at the time of the *Hyde* testimony, 1912, aggregate recoveries of $9,000,000 and at the time of the trial in the instant case, 1923, aggregate licensed tonnage greatly exceeding 169,000,000 tons of ore) demonstrates that while the results achieved during the first period were remarkable and revolutionary, yet when compared with the stupendous figures of the later period, they sink into relative unimportance. The invention of the patent in suit has been, in its practical benefits to society in creating wealth and conserving the mineral resources of the earth, the greatest invention ever made in the metallurgical art.

Petitioner's Briefs and arguments in the prior litigations as well as in the instant case have been with meticulous care based upon the facts proved in each case as to the utility of the invention before the Court and nothing now urged in that regard by petitioner's counsel is contradictory of what was urged in those litigations.

Respondent's Brief, at pages 55 and 56, charges a misquotation by us to support the assertion that the references in patent No. 835,120 to patent No. 777,274 are specifically "confined to the disclosure of oleic acid therein." There is absolutely no basis for this charge. There is no misquotation.

Respondent's Brief on pages 22 and 23 made fragmentary quotations from the testimony of Mr. Higgins which might to the casual reader not referring to the record, convey a wrong

impression. It is only necessary to say in that connection that in the omitted parts of his testimony he made it quite clear that the man skilled in the art attempting to practice the process of patent No. 835,120 would not select substances that dissolve in the pulp. For example, at R., Vol. I, p. 502, Mr. Higgins' complete answer to XQ526, of which the word "Yes" only is quoted, is as follows:

> "A. Yes, but as I said before, if he dissolves the substance then he does not coat the metalliferous mineral particles, and he does not, in my opinion, practice the process of the patent No. 835,120."

Respondent's Brief makes frequent appeals from the theorist to the practical expert in the art. But the appeal is fatal to its every contention and especially to its contention that the process of 962,678 was disclosed in 835,120. That those who were expert in this art in 1908 did not then find in patent No. 835,120 the description of the invention of the patent here in suit No. 962,678 that Respondent's Brief now finds in it, appears from the evidence as to the circumstances under which the invention of patent No. 962,678 was made and as to the necessity that mothered it. See Stipulation as to Elmore litigation (R., Vol. I, pp. 600, 601) and Stevens (R., Vol. I, p. 375) and his reports (R., Deft.'s Ex. 115, Vol. II, pp. 1106-1184) and the efforts there recited to obtain mineral-froth flotation "without the use of oil," [1] "without the addition of oil," [2] "obviating the addition of oil," [3] "in the place of oil," [4] and to provide "substitutes for oil" [5] in order to avoid the Elmore patent. See *infra*, pages 21, 22.

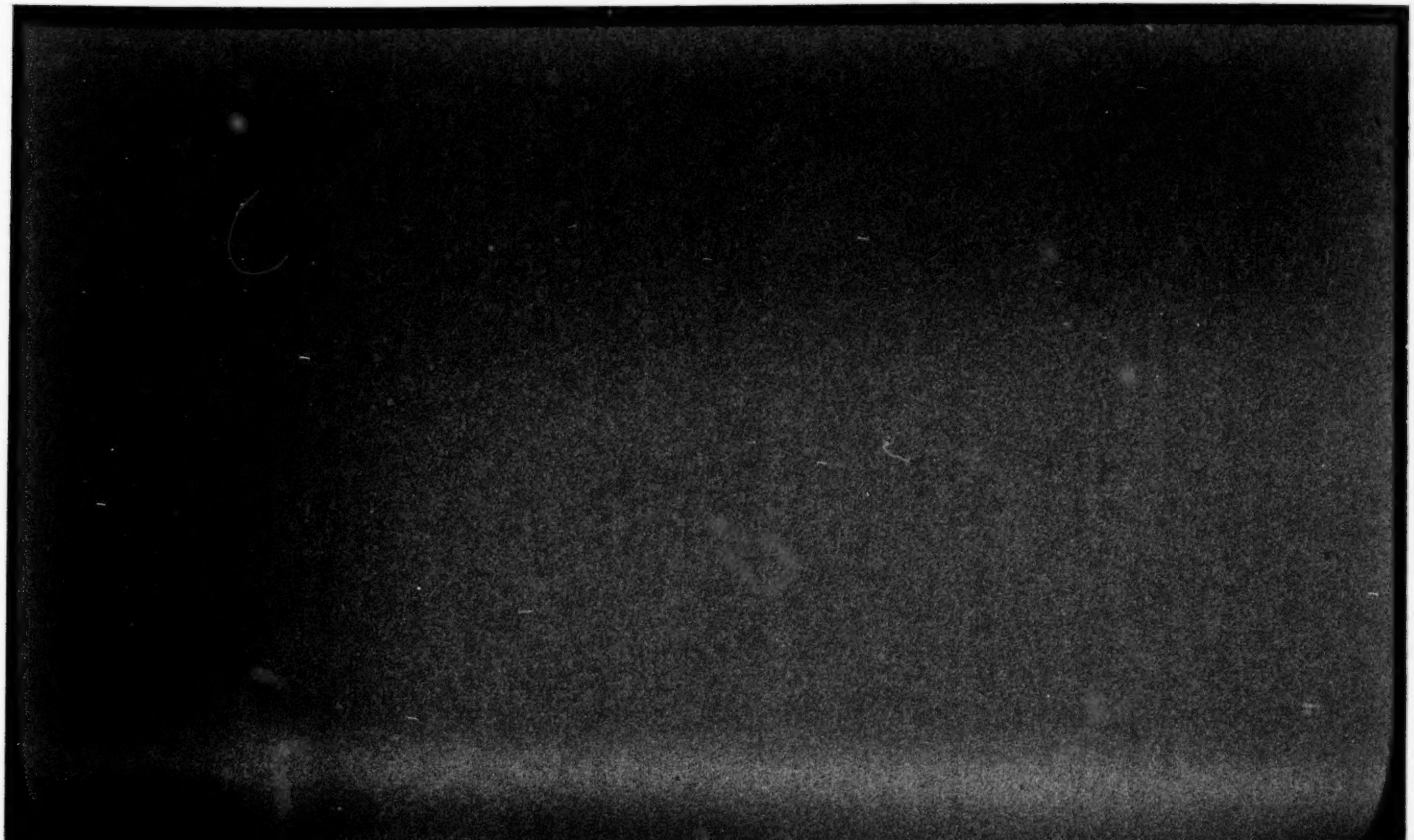
In conclusion as to the first defense, it is to be noted that the errors of the Court immediately below, pointed out in Petitioner's Brief, are not explained or excused or defended in Re-

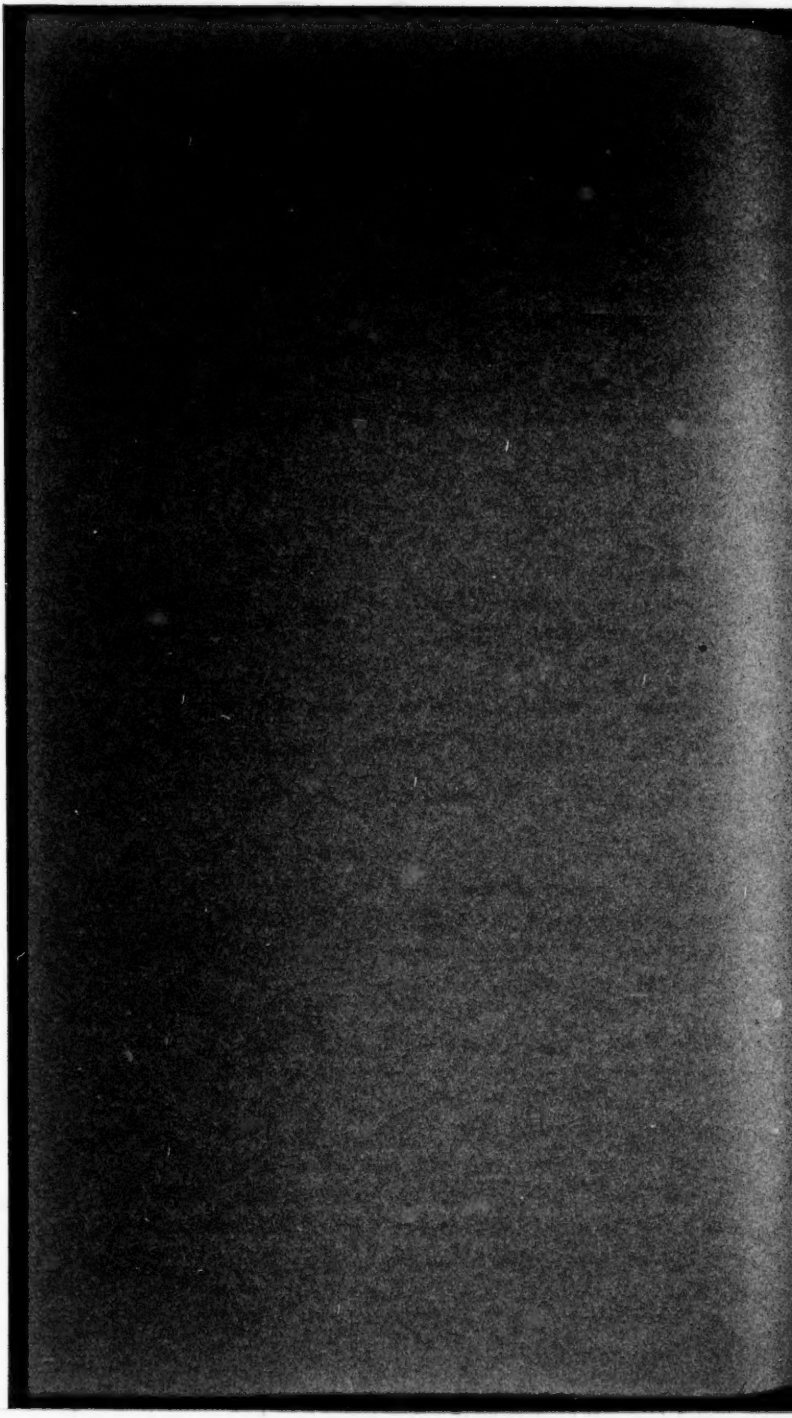
1. R., Vol. II, p. 1106.
2. R., Vol. II, p. 1128.
3. R., Vol. II, pp. 1135, 1136, 1140, 1142, 1149, 1151, 1152, 1159, 1166.
4. R., Vol. II, pp. 1110, 1116, 1120, 1121, 1145, 1165.
5. R., Vol. II, p. 1127.

spondent's Brief, which merely attempts to support the conclusions of that opinion by again presenting the arguments which were presented below and which prevailed only because of misunderstanding and confusion as to the facts of the case. Other matters debated in Respondent's Brief in connection with the first defense appear to have been sufficiently anticipated and considered in Petitioner's Brief.

Respondent's Brief presents arguments as to five other defenses in addition to the first defense above considered and which was the only defense discussed in the opinion immediately below. All of these defenses were argued in both courts below and the trial Court discussed all of them in its opinion except the 2nd and 3rd and found against defendant.

This is a suit in equity, and we take it that an affirmance of the decree of the District Court will require some consideration of all of the defenses here presented and we will, therefore, now consider the defenses numbered from 2nd to 6th.





THE SECOND AND THIRD DEFENSES.

These defenses are parts or aspects of one defense and that defense really is that the owners of the invention in issue, predecessors of Petitioner-plaintiff, in patenting it in England took steps that defeat the patent in this country.

The matter was fully argued in both courts below but the trial Court found against defendant without deeming it worthy of discussion and the Court immediately below held the patent in suit void without adverting to this defense.

The matter is purely technical but since the respondent-defendant deduces from the efforts made to secure patent protection in England, a defense which would be of substance if maintained, namely, that the invention was not the joint invention of the three patentees, Sulman, Greenway and Higgins, we will consider that defense first.

The Third Defense i.e., that the patentees were not Joint Inventors (R. B. pp. 63-68).

The reasoning of Respondent's Brief is as follows:

1. The earliest date available to plaintiff as the date of alleged joint invention is February 1, 1909, the date of filing of Provisional Specification by Sulman, Greenway and Higgins of British patent 2359 of 1909, describing the generic process of the patent in suit No. 962,678.

2. Prior to that date Sulman and Higgins each had knowledge of a specific process within the four corners of that generic process, as evidenced, in the case of Sulman, by the Provisional Specification filed December 24, 1908, of British patent No. 28,173 of 1908 (disclosing an alcohol process—Deft.'s Ex. 68, R., Vol. II, pp. 1054-1057); and, in the case of Higgins, by the Provisional Specification filed December 10, 1908 of British patent No. 26,852 of 1908 (disclosing a phenol process—Deft.'s Ex. 68, R., Vol. II, pp. 1050-1052).

3. Therefore Sulman having knowledge of one part and Higgins of another part prior to February 1, 1909, Sulman, Greenway and Higgins could not, on February 1, 1909, have been joint inventors of the whole.

The reply to this is that on the proofs the date available to plaintiff as the date of joint invention is *December 8, 1908*, and that the Provisional Specifications referred to (of December 10, 1908, and December 24, 1908) are too late to anticipate and moreover they evidence contributions of Higgins and of Sulman, respectively, toward the whole, and merely constitute steps, entirely proper under the English law, toward patenting the whole. Higgins' contribution of the phenol species and Sulman's contribution of the alcohol species were properly separable as species inventions and patentable under the English law (as we shall point out) as such, while at the same time constituting parts of, and contributions toward, the whole, the generic invention, the invention of the February 1, 1909, Provisional Specification.

Thus, the two British provisional specifications of December 10, 1908, and December 24, 1908, do not evidence or tend to evidence the absence of joint inventorship but precisely the reverse.

These matters we shall take up in turn.

The Date of Invention.

The law is that a patentee in this country who made his invention abroad is entitled to carry back his date of invention to the earliest work he did abroad, where originality of invention is in issue or it is necessary to validate his patent as against alleged anticipation.*

We understand this is admitted (R. B., p. 66).

The bill of particulars (R., Vol. I, p. 91) alleged May, 1908, as the date of conception and disclosure of the invention and December 8, 1908, as the date of reduction to practice.

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* *Hanifen* v. *Godshalk*, 78 F. 811; *Hanifen* v. *Price*, 96 F. 435; *Welsbach* v. *American Co.*, 98 F. 613.

It was stipulated (R., Vol. I, pp. 600, 601) that in the Spring and early Summer of 1908 and up to August, 1908, Sulman, Greenway and Higgins were all in London (all being in a common service for Minerals Separation, Ltd., predecessor of petitioner); and that in August, 1908, Higgins went to Australia and returned in March, 1909; that on February 20, 1907, litigation had been commenced against Minerals Separation, Ltd. for infringement of certain Elmore patents for the use of an acidified pulp with oil in an ore concentration process; that on or before October 21, 1908, Mr. Justice Neville's decision [1] (favorable to Minerals Separation, Ltd.) was made; that on December 2, 1908, Mr. Justice Fletcher Moulton rendered the decision of the Appellate Court [2] (reversing the lower court on the issue of infringement). The serious and alarming situation for Minerals Separation, Ltd. that was created by this reversal was happily relieved a year later (November 16, 1909) by the House of Lords, [3] who reversed Mr. Justice Fletcher Moulton (R., Vol. I, p. 600), but meantime the necessities of its commercial situation drove it and its experts and inventors forward in their work on a froth flotation process that would do away altogether with the use of oil.

Plaintiff's *prima facie* proofs did not call for proof of date of invention.

Defendant's proofs furnished, in the stipulations and in the testimony of Stevens and in the records and documents introduced through, or in connection with, his testimony, all the evidence required both of date of invention and of the fact of joint inventorship.

This evidence (R., Vol. I, p. 375, 376 and Vol. II, pp. 1107-1184) shows that, within a week of Mr. Justice Fletcher Moulton's unfavorable decision holding that the process of 835,120 as used in an acidified pulp infringed the Elmore patents, and on December 8th and 9th, 1908, Stevens was at work in London under the immediate direction of his superiors, including Sulman and Greenway, and in part on suggestions which Higgins

1. *British Ore Concentration Syndicate, Ltd.* v. *Minerals Separation, Ltd.* (High Court of Justice, Mr. Justice Neville) 25 R. P. C. 741.
2. *Same* v. *Same* (Court of Appeal) 26 R. P. C. 124.
3. *Same* v. *Same* (House of Lords) 27 R. P. C. 33.

had communicated to Minerals Separation, Ltd., reducing the generic invention to practice and testing it out in some of its many possible forms of embodiment. This work continued intensively through December, 1908, and January, 1909, and some of it continued later. Stevens' reports (Deft.'s Ex. 115, R., Vol. II, pp. 1106-1184) show tests on December 8, 1908 (R., Vol. II, p. 1107) and December 9, 1908 (pp. 1108 and 1109) with carbolic acid (phenol) as the mineral-frothing agent, reported to Minerals Separation, Ltd. twice on December 11, 1908 (pp. 1106 and 1110), one of the reports beginning (p. 1106) "I beg to report results of tests made on Broken Hill ore without the use of oil," and one of the enclosures being headed (p. 1111) "Results of Tests on Frothing without oil." Tests continued on December 13th, (p. 1117), December 16th (p. 1118) and December 18 (p. 1119) reported on December 23rd (p. 1116). On December 30, 1908 (p. 1120), report was made of "Bottle tests for Mr. Greenway, using various reagents in the place of Oil" (p. 1121). Among the last group of reagents were included amyl alcohol (p. 1122). This work continued intensively through January, 1909 (pp. 1123-1150) and included (p. 1132) "Result of Experiments carried out with amyl alcohol and amyl acetate." This testing and experimental and development work shows unusual diligence in adapting and perfecting the invention. As it progressed Minerals Separation, Ltd., the owner, caused Provisional Specifications to be filed in the British Patent Office (as it had the right to do under the peculiar English law in that regard) which might subsequently within a time limited by the law be treated as applications for patents if Minerals Separation, Ltd. so elected, one on Dec. 10, 1908 (No. 26,852 of 1908), in its own name as a communication from Mr. Higgins, then in Australia, for a process using the "aromatic hydroxy compound" group of agents "such as phenol, cresol, etc." (Deft.'s Ex. 68, R., Vol. II, p. 1051), another on December 24th, 1908 (No. 28,173 of 1908) in the names of Sulman, Picard and Ballot, for a process using the "alcohols" group of agents "such as amyl-alcohol" (Deft.'s Ex. 70, R., Vol. II, p. 1054), and a third on Feb. 1st, 1909 (No. 2,359 of 1909) in the names of Greenway, Sulman and Higgins for the process using

any one of the entire class of "organic substances" "in solution" "which enable metallic sulphides to float" "in the form of a froth" (Deft.'s Ex. 75, R., Vol. II, p. 1080), the last provisional specification including the subject matter of the other two insofar as they were limited to froth-flotation and much more besides. These Provisional Specifications were all signed by "Boult, Wade and Tennant," well known "Chartered Patent Agents" of London. They must be presumed to have known the English law and to have acted strictly in accordance with it. We shall return to that phase of the matter later.

The next event of importance was the preparation of the application for the patent in suit. It followed the Provisional Specification of Feb. 1, 1909, in covering the process using any one of the entire class of mineral-frothing agents in solution and in including in that class the "aromatic hydroxy compound" group of the December 10, 1908, Provisional Specification, and the "alcohols" group of the December 24, 1908, Provisional Specification, and in ascribing that generic invention to Sulman, Greenway and Higgins.

And on April 20, 1909, in London (Higgins having now returned from Australia), all three men took, and subscribed to, the oath of joint inventorship that is found at page 740 of Vol. II of the Record.

This oath

> "that they verily believe themselves to be the original, first, and joint inventors of the 'Improvements in Ore Concentration' described and claimed in the annexed Specification"

and

> "that no application for patent on said improvements has been filed by them or their representatives or assigns in any country foreign to the United States, except as follows: Great Britain under No. 2359 dated 1st February, 1909 and Australia No. 13947 dated 8th March, 1909"

must be assumed to have been taken in knowledge of all the facts and on advice of counsel as to the legal effect of those facts and honestly and without any mental reservations.

No one of the three men has ever raised any question whatever as to the fact of joint inventorship or any doubt as to

the truth of the oath. Respondent's allegation that the oath is untrue has not a scintilla of evidence in the case to support it.

We return later to discuss the legal effect of the oath and the great burden that it put upon Respondent to disprove the truth of the fact sworn to in it by all three men.

We note that the two claims here in issue were claims 1 and 2 of the application as so sworn to (R., Vol. II, p. 737).

On *April 30, 1909,* the application was filed and in due course issued as a patent No. 962,678 on June 28, 1910 (R., Vol. II, p. 753).

In England Minerals Separation, Ltd. on *June 24, 1909,* elected to file complete specification for No. 28,173 of 1908 (Prov. Spec. filed Dec. 24, 1908) which was accepted March 24, 1910 (D. Ex. 68, R., Vol. II, 1054); and on *June 28, 1909,* complete specification of No. 26,852 of 1908 (Prov. Spec. filed Dec. 10, 1908) which was accepted Feb. 10, 1910 (D. Ex. 68, R., Vol. II, p. 1051) and also of No. 2,359 of 1909 (Prov. Spec. filed Feb. 1, 1909) which was accepted March 1, 1910 (D. Ex. 75, R., Vol. II, p. 1080). This latter was later amended, as permitted under the English law, by disclaiming "the inventions claimed in the prior patents No. 26,852 of 1908 and No. 28,173 of 1908" (R., Vol. II, p. 1089, lines 46, 47).

Later, for the purpose of patenting in the United States the "alcohols" group of No. 28,173 of 1908 (Prov. Spec. filed Dec. 24, 1908), as a species of the broad invention, application for patent corresponding to that British patent was sworn to by Sulman as his sole invention on Nov. 9, 1909 (R., Vol. II, p. 1070) and filed on Nov. 22, 1909 (p. 1064) and issued on April 12, 1909, as patent No. 955,012 (D. Ex. 71, R., Vol. II, p. 1058-1062. File Wrapper and Contents pp. 1063-1078).

There was no inconsistency between Sulman's oath of joint inventorship of April 20, 1909, to the application for the patent in suit, and this oath of sole inventorship of Nov. 9, 1909, to the application for 955,012, because those two applications and patents do not claim the same invention; they are not interfering patents; they were co-pending applications and the Patent Office discovered no interference between the claims and no inconsistency between the oaths. On the contrary the in-

ventions are related as genus and species and there is no inconsistency between joint inventorship of a generic invention with others and sole inventorship of a species invention that lies within the four corners of the generic invention.

In all this history, which we have now completed, there is nothing to raise the slightest doubt as to the truth of the oath of joint inventorship made by all the actors in the transaction; and nothing estopping them or petitioner from standing on that oath.

THE BRITISH PATENT LAW.

Nothing in the British Patent Law or in the steps that Minerals Separation, Ltd., the owner, took to secure patent protection in England for the broad invention here in suit, destroyed its right to patent that invention in this country or affected or affects the question of joint inventorship or the question of validity of the patent in suit.

Langner, called by defendant, who was expert in the British Patent Law, testified with regard to that law and to its bearing on this case.

The application for British patent No. 26,852 of 1908 was filed by Minerals Separation, Limited, of London, on December 10, 1908, as a communication from Arthur Howard Higgins, of Broken Hill, New South Wales, Australia (R., Vol. II, p. 1051), then the temporary residence of Mr. Higgins. This method of patenting is a peculiar feature of British law. An invention communicated from abroad by any one who has knowledge of it may be patented by any person in England who has received the communication. The latter, although only the importer, may obtain a valid patent (Langner, R., Vol. I, p. 410, Q8).

The provisional specification of this British patent was filed December 10, 1908, and discloses a froth-flotation process employing as a mineral-frothing agent in solution an (R., Vol. II, p. 1051, lines 7-9):

> "aromatic hydroxy-compound such as phenol, cresol, salicylic acid or salicylates, hydroquinone, picric acid, pyrogallic acid."

The patent in suit No. 962,678 broadly covers processes employing these substances, specifying "phenol and its homologues" and in addition specifying (R., Vol. II, p. 664, lines 33-36):

> "amyl acetate and other esters; * * * benzoic, valerianic and lactic acids; acetones and other ketones such as camphor."

Claims 1 and 2 of the patent in suit are for the froth-flotation process of ore concentration achieved by the use of any one of the entire class of soluble mineral-frothing agents, whereas the British provisional specification No. 26,852 of 1908 discloses only a froth-flotation process of concentrating ores achieved by the use of one group of soluble mineral-frothing agents. Insofar as these two things overlap, that is to say, insofar as they have anything in common as to the mineral-frothing agent employed, the patent in suit is broad and generic and the British provisional specification No. 26,852 of 1908 is narrow and specific.

Just as any specific improvement on a broad invention is within the scope of the broad invention so is the specific improvement of the British provisional specification No. 26,852 within the scope of the invention pointed out by claims 1 and 2 of the patent in suit.

Mr. Higgins nowhere claims to have been the sole inventor of the broad invention of claims 1 and 2 of the patent in suit, nor does he anywhere make the additional disclosure found in the patent in suit and not found in British Provisional Specification No. 26,852 of 1908,—"amyl acetate and other esters, * * * benzoic, valerianic and lactic acids; acetones and other ketones, such as camphor."

The British Provisional Specification No. 26,852 of 1908, thus contained a limited and specific disclosure and, of course, no claims. It was under the British law a mere placing on secret record of a description upon which, at a later time, a complete specification and claims could be based, should the owner later elect to file a complete specification.

And later on, Minerals Separation, Limited, elected to follow up its rights under the British law in this connection, and filed,

on June 28, 1909, a Complete Specification, and that Complete Specification repeated the specific disclosure and *claimed only* the froth process of ore concentration in "slightly acidified water containing in solution a minute [small] quantity of *aromatic hydroxy-compound such as phenol.*"

Plaintiff's rights under the patent in suit had vested before that time, as we have seen, and could not be affected by the subsequent fate of the British Provisional Specification No. 26,852 of 1908.

In an entirely similar way and for precisely the same reasons, Minerals Separation, Ltd., on December 24, 1909, filed Provisional Specification No. 28,173 of 1909 (D. Ex. 68, R., Vol. II, pp. 1054, 1057) and in the name of Sulman, Picard and Ballot (as was permitted under British law, namely, joining owners with inventors) and for processes involving the use of "certain alcohols, such as amyl-alcohol," and including froth-flotation processes.

The "alcohols" group are mineral-frothing agents in solution of the patent in suit and so again the relation of this British Provisional Specification of December 24, 1908, in so far as it discloses the use of the alcohol group in a froth-flotation process, to the process of the patent in suit, is that of species to genus.

Here again, but, as before, after the rights of the patentees of the patent in suit had vested in this country, Minerals Separation, Ltd. elected to file a complete specification with claims and did so on June 24th, 1909, and some of the claims are for a froth-flotation process using certain of the alcohols as flotation agents.

The filing of the two *British Provisional Specifications on December 10th and 24th, 1908, respectively, merely gave to the owner of both a record date in England for the patenting of the particular species disclosed in those respective provisional specifications*, which dates would be good as against any subsequent applicant for a British Patent for the same species. It was the privilege of the owner of the rights so secured to crystallize the same by the filing at any time within nine months thereafter of a complete specification containing a fuller de-

scription and also containing claims exactly defining the invention sought to be patented, and when these rights were so crystallized and defined in the two cases we are considering, they pointed out different inventions in the eyes of the law from those pointed out and claimed in the patent in suit.

The whole body of evidence as to what was done in England prior to February 1st, 1909, including that of Stevens and his reports and the British Provisional Specification No. 26,852 of 1908 filed December 10, 1908, and the British Provisional Specification No. 28,173 of 1908 filed December 24, 1908, tends to show participation by Sulman, Greenway and Higgins in a joint enterprise which culminated in the filing of the *British Provisional Specification No. 2,359 of 1909,* on February 1st, 1909. The latter was filed by Greenway, Sulman and Higgins. It describes the froth-flotation process of the patent in suit and broadly describes processes employing organic mineral-frothing agents in solution, and says as to these mineral-frothing agents (R., Vol. II, p. 1086, lines 16-29):

> "Among the organic substances which in solution we have found suitable with certain ores are acetic acid, propionic acid, butyric acid, valerianic acid, lactic acid, methyl-, ethyl-, propyl-, butyl-, amyl alcohols, glycerine-ethereal salts such as ethyl acetate, amyl acetate; phenol, cresol and their homologues and many of their derivatives, such as resorcin, trinitrophenol, salicylic acid; acetone and other ketones or aldehydes such as formaldehyde and furfural, or mixtures of these. These are all more or less effective in the presence of an acid such as sulphuric, and are given as types; but are not intended to form an exhaustive list of suitable organic substances which may be used in this manner and for these objects.
>
> "On the other hand there are many organic compounds which in solution will not substantially effect the result described, such as some sugars, dextrine, albumen, etc., and a simple test is required in the case of varying ores or materials to determine which organic compound is most suitable."

This includes all of the agents specifically disclosed in the British Provisional Specification No. 26,852 of 1908 (ascribed

to Higgins) and in the British Provisional Specification No. 28,173 of 1908 (ascribed to Sulman), and much more besides.

Under British law, as above stated, all questions of priority as between rival inventors are determined by the date of the filing of the provisional specifications (Langner, R., Vol. I, pp. 415, 416, XQs 34, 35). Hence it is the practice to file provisional specifications as promptly as possible when the development of the invention warrants the filing (XQ36). Nine months are allowed thereafter for filing the complete specification (XQs37, 38). Therefore the only method of obtaining a provable date of invention in England is by the filing of a provisional specification and this undoubtedly prompted the filing of provisional specification No. 26,852 of 1908 on December 10th and the filing of British provisional specification No. 28,173 of 1908 on December 24th of that year, each describing a species of the invention, and the filing of the British provisional specification No. 2,359 of 1909 on February 1st of that year, when the tests warranted it, for the broad invention including all its species.

Under British law it was then (i. e., after Feb. 1st, 1909) open to Minerals Separation, Limited, the owner of all three, to take either of two courses, namely, first, it could abandon the first two provisional specifications and secure a single British patent for the aggregate subject matter of all three based on the provisional specification of February 1, 1909 (*but with priority limited to February 1, 1909*), or, secondly, it could take out a patent for the species of the December 10th, 1909, specification (thereby obtaining the benefit of the date December 10, 1908, as to priority for that species), another patent for the species of the December 24th, 1908, specification (likewise obtaining the benefit of the date December 24, 1908, as to priority for that species), and a third patent based on the February 1, 1909, specification (limited in England as to priority to February 1, 1909) for that precise residue of the broad invention that would be left over after subtraction by specific disclaimer of the subject matter of the other two species. A peculiar disclaimer of that kind, although unknown to the United States patent law, is permissible under the British patent law and

actually was made in this instance (Langner, R., Vol. I, pp. 406-409, Qs4-7; pp. 418, 419, XQs54-57).

The first course would have been the more natural course to pursue, for the monopoly of the first two species would in that event have lasted a month or two longer because the date of the patent for the whole would have been February 1, 1909. That course, however, would have involved the risk that someone else might have in the interim filed a British provisional specification for one or both of the same inventions. If so, such other person would have had the right to the patent to the exclusion of Minerals Separation, Limited. The latter had no means of knowing at that time nor for many months afterward whether or not such intermediate provisional specification had been filed by some hostile interest.

The advantage of taking the second course was that as to the two specific inventions the rights of Minerals Separation, Limited, stood on earlier dates. Election between these two courses had to be made under British law within nine months from December 10, 1908, and December 24, 1908, respectively, as to these two specific inventions. Such election was, in fact, made in June, 1909, and ultimately three British patents issued, the three together covering, under the peculiar British laws relating to such a situation, what a single patent based on the provisional specification No. 2,359 of 1909, filed on February 1, 1909 would have covered.

This election of Minerals Separations, Limited, as to its course with respect to British patent protection, came, however, after the United States rights had crystallized and vested by the filing of the United States application on April 30, 1909, for the broad invention, namely, for the entire aggregate subject matter of the three British provisional specifications. Any election subsequently made by Minerals Separation, Limited, as to its British patents and any course of conduct subsequently followed by it with respect to British patent protection, had no effect, and could have no effect under United States patent law to change or alter or abridge in any way the rights in America of the American patentees of the patent in suit.

The Oath of Joint Inventorship.

The oath of joint inventorship that lies at the basis of the grant of the patent in suit (R., Vol. II, p. 740) certainly evidences the fact, and the conclusion and belief of Sulman, Greenway and Higgins as to the fact, that the broad invention was a joint invention, and it certainly negatives any possible inferences to the contrary that might be drawn from the earlier filing of the two British Provisional Specifications in December, 1908, and it is indeed conclusive of the whole question of joint inventorship.

Analyzing the oath of joint inventorship taken by all three it was as to each one of them in the nature of an admission against interest in favor of the other two.* *Sulman by his oath admitted* that he was not the sole inventor of the broad invention and that Greenway and Higgins participated in it. *Greenway by his oath admitted* that he was not the sole inventor of the broad invention and that Sulman and Higgins participated in it. *Higgins by his oath admitted* that he was not the sole inventor of the broad invention and that Sulman and Greenway participated in it. If anyone of them had been called to the witness stand in this case and had sworn that the broad invention was his sole invention, little weight would have been given to it by the Court in view of his earlier admission under oath and against interest to the contrary.**

The law is not technical or meticulous as to the manner of cooperation of joint inventors, or as to the proportionate amount of contribution of each one toward the whole, provided only that in the end a patentable invention has been made and each one has in some way or other contributed something of substance to it.†

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* Testimony or oath to joint inventorship is an admission against interest and is to be given weight accordingly.

See
Lemp v. *Randall*, 146 O. G. 255; 33 App. D. C. 430;
Hoe v. *Kahler*, 12 F. 111.

** See
Schlicht v. *Chicago*, 36 F. 585;
Armat v. *American*, 118 F. 840.

† See
Walker on Patents, 5th Ed., §46, p. 61;
Vrooman v. *Penhollow*, 179 Fed. 926;

(Footnote continued on next page.)

In the case at bar the three inventors have severally taken oath that the invention in issue was a joint invention and no one has taken oath to the contrary, either in this case or in any other case or proceeding. And there is no circumstantial or collateral evidence of any kind negativing the proposition of joint inventorship or showing the falsity of the oath of joint inventorship or tending in the slightest degree in that direction. There is nothing whatever inconsistent in three persons being joint inventors of a broad and generic invention based upon a broad class characteristic and at the same time each one being the sole inventor of some particular species within the four corners of the broad genus.

The Truth or Falsity of the Oath of Joint Inventorship.

The proofs presented by defendant fail to overcome the presumption that arises from the facts (1) that all three of the inventors joined in that oath on April 20, 1909, (2) that the patent issued on the basis of that oath, (3) that no one of the three inventors questions its truth now or asserts its falsity, and (4) that no one representing any one of them or representing any interest derived from any one of them questions its truth or asserts its falsity. The defendant does not derive title from either Sulman, Greenway or Higgins or in any way represent them or any interest derived from them.

Moreover the British patent No. 26,852 of 1908 was not for the same invention as the patent in suit but was for a species where the latter is for the genus, nor does it disclose or cover what the defendant is doing, and the same thing exactly is true of British patent No. 28,173 of 1908.

The defense is purely technical and does not present a scintilla of merit as explaining or justifying defendant's course in infringing the patent in suit.

DeLaski v. *Thropp*, 218 Fed. 458, 464 and 226 Fed. 941, 947;
Worden v. *Fisher*, 11 Fed. 505, 506-9;
Consolidated v. *Woerle*, 29 Fed. 449;
Carter v. *Perry*, 8 O. G. 518, Com. Dec. 1875, p. 111;
Collins v. *Coes*, 8 Fed. 517;
Schlicht v. *Chicago*, 36 Fed. 585, 587.

Under these circumstances the burden of proof that rests upon the defendant to establish to the full and complete satisfaction of the Court the fact of the falsity of the oath of joint inventorship is unusually heavy and that burden is not met by the proofs.

Defendant's contention amounts to a charge of fraud by Sulman, Greenway and Higgins and Minerals Separation, Limited (the assignee) upon the public and upon the defendant.

A Heavy Burden of Proof is Upon Him Who Alleges Fraud.

Fraud is never presumed but it must be proved by the party who alleges it and it must be proved clearly. (*Farrar* v. *Churchill,* 135 U. S. 609; *Schreyer* v. *Scott,* 134 U. S. 405; *Gaines* v. *Nicholson,* 9 How. 356; *Jones* v. *Simpson,* 116 U. S. 609.)

In particular the defense of the falsity of an oath of joint inventorship has always been looked upon with disfavor by the courts and the burden of proof put upon a defendant alleging it has always been a heavy one.

A Particularly Heavy Burden of Proof is Upon Him Who Alleges the Falsity of an Oath of Joint Inventorship.

Judge Lurton, speaking for the Sixth Circuit Court of Appeals in *Quincey* v. *Krause,* 151 Fed. 1012, 1017, said:

> "To destroy a patent granted for a joint invention, upon the ground that it was the invention of only one of the patentees, would require very clear evidence of a very reliable character."

Judge Coxe in *Butler* v. *Bainbridge,* 29 Fed. 142, 143 said the defense that two persons to whom a patent has been issued were not in fact

> "joint inventors is so purely formal in character that it cannot be regarded with favor, unless it be shown that the action of the patentees in this regard was disingenuous, or calculated to mislead the defendants."

Judge Wallace, speaking for the Second Circuit Court of Appeals in *DeLaval* v. *Vermont,* 135 Fed. 772, said:

> "The Court below adjudged the patent invalid upon the ground that the defense that Melotte and Reuther were not the joint inventors was satisfactorily established. With this conclusion we are constrained to agree, though we do so with regret, because the defense is purely technical, and destroys a meritorious patent, purchased by the complainant in ignorance of its infirmity, and at a very considerable price."

Judge Woolley, speaking for the Third Circuit Court of Appeals in *Thropp* v. *DeLaski,* 226 Fed. 941, 949 refers to "the rule which requires unquestionable proof that joint patentees are not joint inventors."

Judge Coxe, speaking for the Second Circuit Court of Appeals in *United Co.* v. *Beattie,* 149 Fed. 736, 741, said of a similar situation:

> "The question is at best a technical abstraction. * * * A decision against Pine now will benefit infringers but will be no benefit to Dormandy. We think the testimony fails to establish the defendants' contention."

Robinson on Patents, pages 571, 572, note 1, protests against the harshness of the law which holds a patent invalid if the sole inventor has admitted someone else to a share therein as joint inventor with him and argues:

> "So far, therefore, as the public are concerned, there is no reason why the patent should be treated as invalid, if on any principle of law or equity the grant, as made, can be upheld. * * * Certainly his rights as sole inventor are not vindicated by declaring the entire patent void, and depriving him of his reward because he has improperly though honestly allowed another to obtain a share therein."

Walker on Patents, 5th Ed, page 65 §51, says:

> "But very convincing evidence is required to establish the invalidity of a patent on the ground stated in this section" [i. e., Joint invention where in fact there has been sole invention].

The question has arisen in various ways in many cases and the study of these cases where the question of joint or sole inventorship arose is interesting. But always the courts have hesitated to strike down and destroy a valuable piece of property because of a purely technical defense which could not possibly hurt or mislead any one and which did not in fact mislead the defendant into committing an infringement and which in no way induced or justified the infringement. The courts constantly seek to reconcile the evidence with the oath on which the grant is based and only declare the grant invalid and void where the evidence is clear and convincing and the facts indubitably proved are necessarily inconsistent with the basis of the grant.

The attitude of the Patent Office is well indicated in the following:

In *Carter* v. *Perry,* 8 O. G. 518, 519, C. D. 1875, 111, 114, the Commissioner of Patents, where two of the parties before him had in their application for patent made oath that they were joint inventors, said:

> "* * * I do not think I should be justified in going behind their oath, unless constrained by evidence perfectly clear and inexplicable on any other hypothesis than that of independent invention."

Decisions on the Question of Fact of Joint or Sole Inventorship in Particular Cases.

A careful search of all the published authorities in this country has disclosed to us only four cases during a period of more than one hundred years in which a patent that had issued as for a joint invention was declared invalid on the ground that the invention was not in fact joint.*

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* In *DeLaval Separator Co.* v. *Vermont Farm Machine Co.,* 135 Fed. 772, the defense (that the invention was not in fact joint) was held proved and the patent was declared invalid though with reluctance.

In *Stewart* v. *Tenk,* 32 Fed. 665, the defense was held proved as to one claim out of twelve.

In *Heulings* v. *Reid,* 58 Fed. 868, the defense was sustained but at the same time the defense of non-invention was also sustained.

In *The Union Bag Machine Co.* v. *The Atlas Bag Co.,* 6 Fed. 398, the defense was sustained but a defense of prior use was at the same time sustained.

In one other case, namely, *Welsbach Light Co.* v. *Cosmopolitan Incandescent Light Co.,* 104 Fed. 83, a preliminary injunction was denied because of doubt on the question of joint inventorship.

On the other hand this investigation has disclosed twenty-four cases in which the defence was made but was overruled as not proven.**

A study of all these cases and of the sort of evidence considered by the courts and held sufficient or insufficient as the case might be to establish the defense, will deeply impress the student of the subject with the fact that such a defense can only prevail upon the clearest and most convincing sort of evidence. Such evidence is wholly lacking in this case.

The Second Defense, i.e., of prior patenting and/or prior inventing by Sulman.

What Respondent's Brief calls the second defense, namely, alleged (1) prior patenting by Sulman by patent No. 955,012 and/or (2) prior invention by Sulman, is even more technical than the defense just discussed and is fully answered by the facts that we have set forth.

** *American Patent Diamond Dop Co.* v. *Wood*, 189 Fed. 391;
Ashcroft v. *Cutter*, Fed. Cas. No. 578; 6 Blatchf. 511;
Armat Moving Picture Co. v. *American Mutoscope Co.*, 118 Fed. 840;
Belle Patent Button Fastener Co. v. *Lucas*, 28 Fed. 371;
Butler v. *Bainbridge*, 29 Fed. 142;
Cheshire v. *Cox Multi-Mailer Co.*, 229 Fed. 415;
Consolidated Bunging Apparatus Co. v. *Woerle*, 29 Fed. 449;
Coburn v. *Schroeder*, 8 Fed. 521;
DeLaski & Thropp Co. v. *Thropp & Sons Co.*, 218 Fed. 458 (affirmed 226 Fed. 941);
Gottfried v. *Phillip Best Brewing Co.*, 5 Ban. & A. 4, Fed. Cas. No. 5633;
Hoe v. *Kahler*, 12 Fed. 111;
Hotchkiss v. *Greenwood*, 4 McLean 456, Fed. Cas. No. 6718;
Minerals Separation, Ltd. v. *Hyde*, 207 Fed. 956; 242 U. S. 261;
Priestley v. *Montague*, 47 Fed. 650;
Quincey Mining Co. v. *Krause*, 151 Fed. 1012;
Sterns v. *Barrett*, Fed. Cas. No. 13337; 1 Mason 153;
Selectasine Patents Co. v. *Prest-O-Graph Co.*, 267 Fed. 840 (affirmed 276 Fed. 260, C. C. A. 9);
Sieber & Trussel Mfg. Co. v. *Chicago Binder & File Co.*, 177 Fed. 439;
Schlicht & Field Co. v. *Chicago Sewing Machine Co.*, 36 Fed. 585;
Slemmer's Appeal, 58 Pa. St. 155;
The Collins Co. v. *Coes*, 8 Fed. 517;
Vrooman v. *Penhollow*, 179 Fed. 296;
Worden v. *Fisher*, 11 Fed. 505;
Scherzer Bridge Co. v. *Chicago*, 2 Fed. (2d) 601, affirmed by C. C. A. 7. 11 Fed. (2d) 605.

It is based on the fact that Minerals Separation, Ltd., besides patenting the generic invention in the United States, elected also to patent in the United States the Sulman contribution toward that generic invention, i. e., the process using the "alcohols" species. But it is quite clear that this was accomplished without forfeiting any rights.

As to *prior patenting* by patent No. 955,012, it is true that that patent issued a few weeks before patent No. 962,678, namely, on April 12, 1910 (D. Ex. 71, R., Vol. II, pp. 1058-1062) whereas patent No. 962,678 did not issue until June 28, 1910. But the invention of the latter was made long prior to April 12, 1910, as evidenced for one thing by the fact that the application for that patent No. 962,678 was filed on April 30, 1909. So 955,012 was not a *prior patent.** Indeed the application for 955,012 was not filed until November 22, 1909.

As to *prior invention* by Sulman, Sulman was not a stranger to the patentees but was one of them. Therefore the defense of prior invention by him disappears altogether, because his thoughts and acts that respondent stands on in that connection were a part of Sulman's constructive work and contribution toward the generic invention, and give date to that generic invention as much as to any specific invention. No part of that work was prior art to any other part.

Moreover the generic invention had, prior to December 24, 1908 (the date of filing of the Provisional Specification No. 28,173 of 1908), been reduced to practice in England, as we have seen, and as early as December 8, 1908, and in other specific forms than those ascribed to Sulman on December 24th, 1908. So that, as to the latter—the specific "alcohols" process invention of patent No. 955,012—, the generic invention in some of its forms (e. g., the carbolic acid, that is, the phenol process) was prior instead of the reverse.

Therefore the *Milburn* case and the *Yeast* case cited on pages 61 and 62 of Respondent's Brief have no bearing whatever on

* *Bates* v. *Coe*, 98 U. S. 31; *Dubois* v. *Kirk*, 158 U. S. 58, 64; *Anderson* v. *Collins*, 122 Fed. 451, 458 (C. C. A. 8).

the facts of the present case, and the argument made on pages 59 to 63 is wide of the mark.

Every related fact and circumstance in the case shows that the generic invention in suit—the joint invention of Sulman, Greenway and Higgins—was not anticipated by the specific invention which is the subject-matter of patent No. 955,012 and of its corresponding British patent No. 28,173 of 1908, and which specific invention was the sole invention of one of them, to wit, Sulman. This Sulman alcohol patent No. 955,012 is obviously *not an interfering patent* with No. 962,678, and so is for a different invention in the eyes of the law from that of No. 962,678, and in so far as it discloses and claims a froth-flotation process (claims 4, 5 and 6), it in substance *disclaims the generic invention of the patent in suit* by merely claiming the "alcohols" process species. The oath of Sulman, filed as part of the application for patent No. 955,012, executed November 9, 1909 (R., Vol. II, p. 1070), and filed November 22, 1909 (p. 1064), was that he was "the original, first, and *sole* inventor of the 'Improvements in the Concentration of Ores' described and claimed in the annexed Specification," to wit, the alcohol process. Before making that oath, as we have already pointed out, he had joined in the making and filing in the United States Patent Office of the joint oath of himself, Greenway and Higgins that they were "the original, first and *joint* inventors of the 'Improvements in Ore Concentration' described and claimed in the annexed Specification," to wit, the broad invention of claims 1 and 2 and other claims of the application for the patent in suit. By these two solemn acts Sulman put himself on record on April 30, 1909, as a joint inventor of the broad invention of the patent in suit, and on November 22, 1909, as the sole inventor of the alcohol process.

The burden was on respondent to clearly prove its allegation of prior invention by Sulman. This it has failed to do.

In the case of *Minerals Separation* v. *Hyde, supra,* defendant attacked inventorship and joint inventorship, issued an open commission to examine the inventors abroad, and adduced the testimony of the joint inventors and of Mr. Higgins, on which evidence this Court adjudged joint inventorship in the

patentees of patent No. 835,120. Defendant here could have proceeded similarly. Mr. Higgins, here one of the joint inventors, was in fact present at the trial under defendant's subpoena, although defendant elected not to examine him as its witness on any part of the case. He testified at large, however, for the plaintiff and was cross-examined at length. Defendant having failed utterly to make good its allegation of prior invention by Sulman and having examined Stevens and introduced all of Stevens' reports, plaintiff was under no duty to carry back the joint invention to the date which had been given in its bill of particulars, to wit, "on or about the first of May, 1908" (R., Vol. I, p. 91). December 8, 1908, was early enough. It anticipated the alleged anticipation.

The evidence relied upon by defendant as showing anticipation of the joint invention by the separate work of the joint inventors not only falls far short of proving any defense but is entirely consistent with the assumption that in the Spring and Summer of 1908 the three experimenters were in communication with one another and, both jointly and severally, attacked the problem of ore concentration *without the use of oils* under spur and compulsion of the Elmore litigation and pursued that work thereafter and with particular persistence and intensity from early December, 1908 (after Mr. Justice Fletcher Moulton's unfavorable decision of December 2, 1908), conceiving the broad invention and making contributions to it which separately considered might be regarded as separate and sole inventions but which, all taken together and as a whole, developed the broad and generic invention by the discovery and development and disclosure of the froth-flotation characteristic of soluble mineral-frothing agents in solution as a broad class characteristic and by the defining and delimiting of the metes and bounds of that class.

This would constitute Sulman and Greenway and Higgins joint inventors under the law of the broad invention of the patent in suit, and separate and sole inventors, perhaps, of some of their separate contributions if those also constituted separate patentable subject matter (with the patentability of their separate contributions we are not here concerned). But in

such event the separate contributions would not constitute prior art to the whole, first, because they were part of that whole and give date to it as much as they give date to themselves as separate achievements, and secondly, because the ultimate achievement necessarily and inevitably implied a corresponding original purpose and conception preceding and underlying all their efforts and all their contributions to it. And the oath made by Sulman, Greenway and Higgins on April 20, 1909, in connection with the application for the patent in suit, that they were joint inventors of the broad invention there set out and claimed, makes it a reasonable and indeed a necessary conclusion to reach on the whole evidence that the three collaborated together in making the broad invention and so were joint inventors and that the separate contributions of each did not anticipate the joint whole.

No defense of abandonment or dedication of the generic invention by Minerals Separation, Ltd. can be deduced from, or predicated upon, its efforts to patent that invention, and all its patentable parts, in England and in the United States, that have been recited above, for everything done by it and by Sulman, Greenway and Higgins, or any of them, prior to April 30th, 1909, was secret. The public and the respondent acquired no knowledge and no rights from it either here or in England.

Suffolk Mfg. Co. v. *Hayden*, 3 Wall. 315;
Century Co. v. *Westinghouse Co.*, 191 Fed. 350 (C. C. A. 8);
Higgins v. *Watson*, 263 Fed. 378, 385 (C. C. A. 6);
Thomson-Houston v. *Ohio*, 80 Fed. 712, 724 (C. C. A. 6);
Victor v. *Brunswick*, 286 Fed. 334, 336 (C. C. A. 6);
Ide v. *Trorlicht*, 115 Fed. 137, 145 (C. C. A. 8);
Anderson v. *Collins*, 122 Fed. 451 (C. C. A. 8);
Thomson-Houston v. *Elmira*, 71 Fed. 396, 404 (C. C. A. 2).

FOURTH DEFENSE.

The fourth defense in substance is that the claims in suit are void because they are not limited to an acidified pulp as are other claims in the patent in suit.

The questions to be considered are (1) what was the real invention disclosed by the patent in suit—what was its contribution to the art—and (2) are the claims in suit broader than that real invention, that contribution to the art?

The contribution to the art made by the process in suit was not an acidified pulp. That was old in all sorts of processes employing oils. It was first disclosed in the Everson patent issued in 1886. It was the principal feature of the one Elmore oil-buoyancy patent on which the case of *British Ore Concentration Syndicate, Ltd.* v. *Minerals Separation, Ltd.*, 27 R. P. C. 33, was decided by the House of Lords. It was the principal feature of the corresponding Elmore Australian patent on which the case of *Ore Concentration Company (1905), Ltd.* v. *Sulphide Corporation, Ltd.* (a licensee of Minerals Separation, Ltd.), 31 R. P. C. 206, 222, was decided by the Privy Council of the British Empire. It was disclosed in the Cattermole patents and was not only disclosed in patent No. 835,120 but was extensively used in the great operations in Australia wherein that process was being carried on up to and at the time of the invention of the process in suit. Prior to the invention of the process in suit there were no operations with oil in which an acidified pulp was not used. Patent No. 835,120 disclosed only one example of the carrying on of the process of that patent and that was with an acidified pulp, and an acidified pulp was recited as a limitation in eight of its thirteen claims. In the *Hyde* case claims not limited to an acidified pulp (1, 5 and 12) were held valid and infringed and claims limited to an acidified pulp (2, 3, 6 and 7) were also held valid and infringed. In the *Butte & Superior* case the same claims were held valid and infringed, and additionally claims 9 and 10 (not limited to an acidified pulp), as well as claim 11 (limited to an acidified pulp) were, as limited by disclaimer, held valid and infringed. Thus in that case the same argument of lack of disclosure in patent No. 835,120 could have been made as is made in Respondent's Brief herein as to patent No. 962,678, since there was no *disclosure* in 835,120 of any procedure wherein an acidified pulp was not used. In that patent as in the patent in suit, claims not limited to an acidified pulp were

associated in the same patent with claims limited to an acidified pulp, and in the *Hyde* and *Butte* suits, as stated, claims of both sets were in issue and were held valid and infringed. The fact that the Specification of 835,120 refers to the use of an acidified pulp as preferential is not a disclosure of a process wherein acidified pulp is not used. In legal effect it is merely a suggestion in the specification of a differentiation that is definitely made in the claims. Such a suggestion in the specification is not required by law as a prerequisite to such a differentiation in the claims. The whole document is a unit and it is the function of the claims (and not necessarily also the function of the specification) to point out what part of the whole disclosure is new.

The question of the validity of claims 1 and 2 of the patent here in suit was acutely presented in the *Miami* case to the Circuit Court of Appeals for the Third Circuit, for the reason that the defendant there did not use an acidified pulp, and for the further reason that the Greenway patent No. 1,099,699 (from the file of which Respondent's Brief quotes at great length, pp. 73-77) was also before that court for adjudication on an allegation by the defendant there that it was anticipated by the patent here in suit No. 962,678, and was held by that court to be valid and infringed (244 Fed. at 774, 775) reversing the trial Court.

In the opinion of the Circuit Court of Appeals for the Third Circuit, Judge Woolley said relative to the disclosure of the patent here in suit and claims 1 and 2 thereof (*Minerals Separation, Ltd.* v. *Miami Copper Co.*, 244 Fed. at 773):

> "We may also note that while the addition of an acid to the mineral-frothing agent is described as part of the process, this was at that time a usual practice, and in any event is not an element in the claims now in issue."

Judge Peters in the instant case said as to the same subject (R., Vol. I, pp. 623, 624):

> "It was widely understood at that time [when the process in suit was invented] that nothing but an acid proc-

> ess would work in their concentration process, and it was the general custom to use an acidified pulp. This, however, was not a part of the contribution by the patentees to the flotation art. What they contributed was a process of froth-flotation employing a mineral-frothing agent in solution. Even if the patentees did not know that the process described by them could be carried on with an alkaline pulp, they did not limit themselves in that respect and it is sufficient if the real novelty of their invention is broad enough to support the claims, as it appears to be."

In view of the fact that the patent in suit is a process patent, we cite the definition by this Court (Mr. Justice Bradley) of a patentable process (*Cochrane* v. *Deener*, 94 U. S. 780, 788):

> "A process is a mode of treatment of certain materials to produce a given result. It is an act, or a series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing. If new and useful, it is just as patentable as is a piece of machinery. In the language of the patent law, it is an art. The machinery pointed out as suitable to perform the process may or may not be new or patentable; whilst the process itself may be altogether new, and produce an entirely new result. The process requires that certain things should be done with certain substances, and in a certain order; but the tools to be used in doing this may be of secondary consequence."

Acidification of the pulp as generally practiced at the time of the invention of the process in suit and as practiced to some extent today, is for a definite purpose. Sulphuric acid is generally used and it acts "as a gangue-corrective" (Chapman, R., Vol. I, p. 558, Q153; p. 559, Q155). As we show in Petitioner's Brief (pp. 51, 52), of the eighty licensees of the plaintiff whose reagents are proved, seven of them acidify their pulps, in each case with sulphuric acid. The metallurgist uses acidification where it is advantageous or required as a gangue-corrective and refrains from its use and the expense of its use whenever the nature of the ore or the practical conditions of treatment permit.

We come now to consider what the patentees of the patent in suit contributed to the art of ore concentration—what was their real invention. They contributed, as Judge Peters said,

> "a process of froth-flotation employing a mineral-frothing agent in solution."

It was not the first process of froth-flotation. That had been contributed by the process of patent No. 835,120, but that process was achieved by employing an oil, fatty acid or other substance having a preferential affinity for metalliferous matter over gangue, used in a proportion which was a fraction of 1% on the ore, and acting to coat the metalliferous mineral particles and attain a mineral-bearing froth in that way. The process of the patent in suit is a second and a different process of froth-flotation, achieved through the employment of a mineral-frothing agent in solution which stays in solution and attains a mineral-bearing froth in that way. As we point out in Petitioner's Brief, that process is fully described in the Specification in one form (P. B., pp. 26-37) and is distinctly claimed in the claims in issue in every form (P. B., pp. 37-39).

The applicable Statute is as follows (U. S. C. Tit. 35, Sec. 33; R. S. Sec. 4888):

> "Sec. 33. *Application for patent; description; specification and claims.* Before any inventor or discoverer shall receive a patent for his invention or discovery he shall make application therefor, in writing, to the Commissioner of Patents, and shall file in the Patent Office a *written description of the same, and of the manner and process of* making, constructing, compounding, and *using it,* in such full, clear, concise, and exact terms as to enable *any person skilled in the art* or science to which it appertains, or with which it is most nearly connected, *to* make, construct, compound, and *use the same;* and in case of a machine, he shall explain the principle thereof, and the best mode in which he has contemplated applying that principle, so as to distinguish it from other inventions; *and he shall particularly point out and distinctly claim the part, improvement, or combination which he claims as his invention or discovery.* The specification and claim shall be signed by the Inventor."

Claims 1 and 2 of the patent in suit "point out and distinctly claim" what the patentees broadly claim as their "invention or discovery." They follow a specification which gives a written description of the process and of the manner of using it, "in such full, clear, concise, and exact terms as to enable any person skilled in the art * * * to * * * use the same." The specification and claims are addressed to the man skilled in the art. Claims 1 and 2 define and measure the invention in its broad scope and are not limited by the specification to the specific examples thereof.

In *Tilghman* v. *Proctor,* 102 U. S. 707, 732, this Court said:

> *"The patentee showed one method in which the heat could be applied.* That was all that was necessary for him to do. If it could be applied in any number of different methods, it would not affect the validity of the patent as a patent for a process."

As this Court has said "the claims measure the invention" and the "description does not necessarily limit the claims." We cite here *Continental Paper Bag Co.* v. *Eastern Paper Bag Co.,* 210 U. S. 405, wherein the invention was a machine and under the second part of the statute the patentee was called upon to explain the principle of his invention and the best mode in which he has contemplated applying that principle. The present invention being a process the first part of the statute applies and the particular requirements provided for the "case of a machine" do not apply, and so it is enough that the specification describes the manner and process of using the invention, in one workable example (which was demonstrated at the trial), and that the claims point out and distinctly claim that part of what is described which the patentees assert to be their invention or discovery. In the cited case, *Continental Paper Bag Co.* v. *Eastern Paper Bag Co., supra,* this Court (Mr. Justice McKenna) discussing the specification and claims of a patent there in suit for a machine, said (p. 418):

> "he filed a description of his invention, explained its principle, and the best mode in which he 'contemplated

> applying that principle' and did not intend to give up all other modes of application. An inventor must describe what he conceives to be the best mode, but he is not confined to that. If this were not so most patents would be of little worth. 'The principle of the invention is a unit, and invariable; the modes of its embodiment in the concrete invention may be numerous and in appearance very different from each other.' 2 Robinson, Patents, Sec. 485. The invention, of course, must be described and the mode of putting it to practical use, *but the claims measure the invention.* They may be explained and illustrated by the description. * * * *the description does not necessarily limit the claims."*

Obviously as to the process patent here involved the same general rules as to claims apply, the claims measure the invention and the description does not necessarily, and in this instance does not in fact, limit the claims.

FIFTH DEFENSE.

The fifth defense is in substance that the claims in issue are not infringed because as a matter of construction they must be limited by the specification to a process employing an acidified pulp; and defendant's pulp is not acidified. Respondent's Brief considers together this defense and the Fourth defense (R. B., pp. 69-81) and it is obvious that if the claims are valid as made and point out and measure the real invention and the defendant's process is such a process as is pointed out in the claims, the defendant infringes. There is little, therefore, to add since in Petitioner's Brief under the heading of Infringement (pp. 127-130) the process employed by the defendant is fully described, and it is shown that not only is this process the process precisely pointed out in the claims in issue, but that it is also a process describable in the language of the specification (P. B., p. 129), the alkali in the pulp being, with Respondent's ore, the equivalent of the acid as a gangue-corrective.

As to the solubility of the mineral-frothing agent used by the defendant, alpha-naphthylamine or X-cake, it is to be noted that Respondent's Brief makes the following admission (R. B., p. 79):

"In defendant's practice there is added to the ore pulp a small quantity of a mineral-frothing agent which goes wholly into solution in the pulp."

It is a general rule of construction, applicable where there are several claims, that if some of the claims are limited to details others which are not so limited are not to be fettered by insisting that they contain, as necessary elements, particulars which are specifically covered elsewhere. This language is taken almost exactly from *Bresnahan* v. *Tripp Giant Leveller Co.*, 102 Fed. 899, 900 C. C. A. 1.*

Defendant's attempted justification under the Corliss patent No. 1,228,183. Defendant is licensed under this patent, Defendant's Exhibit 126 (R., Vol. II, p. 1222), which discloses a froth-flotation process employing in solution the organic mineral-frothing agent alpha-naphthylamine, commonly known as X-cake.

This Corliss patent does not assert for X-cake in the process any new or different mode of operation or principle of action nor any new result. It is an old and well known organic substance, known to be wholly soluble in the proportions in which it would be used in froth-flotation concentration. It has been found to be a good mineral-frothing agent in solution. Obviously its use is within the scope of the claims in issue. Every generic patent is the foundation for development and improvement, and it is reasonable to expect that the industry of metallurgists in carrying on with different ores the simple tests described in the patent in suit will result in the discovery that substances not specifically named in the patent but within the broad class there described are capable of use in a froth-flotation process as mineral-frothing agents in solution. The propo-

* See also
Parsons v. *Seelye*, 100 Fed. 455, 457, C. C. A. 1;
Cadillac Motor Car Co. v. *Austin*, 225 Fed. 983, 985, C. C. A. 6 (Judge Denison);
City of Akron v. *Bone*, 221 Fed. 944, 946, C. C. A. 6 (Judge Denison);
Automatic Recording Safe Co. v. *Burns Co.*, 231 Fed. 985, 987, C. C. A. 2;
Ryder v. *Schlichter*, 126 Fed. 487, 491, C. C. A. 3;
National Cash Register Co. v. *American Cash Register Co.*, 53 Fed. 367, 370, C. C. A. 3.

sition that such a discovery would carry the substance outside of the patent and would as to that substance take away from the patentees of the broad process their rights under their patent should not receive serious consideration.

In the case of *Tilghman* v. *Proctor*, 102 U. S. 707, this Court (Mr. Justice Bradley), passing upon the question of infringement, stated (p. 731):

> "Or, if the mode of effecting the continued mixture adopted by the defendants should be deemed a new and useful improvement, they might perhaps have a patent for that peculiar device without being entitled to use Tilghman's process, on which it is but an improvement."

The doctrine stated above has been widely followed.*

Again, infringement is not avoided by using an improved or a better reagent.

In *Smith* v. *Nichols*, 88 U. S. 112, this Court (Mr. Justice Swayne) said:

> "A patentable invention is a mental result. It must be new and shown to be of practical utility. Everything within the domain of the conception belongs to him who conceived it. *The* machine, *process* or product *is but its material reflex and embodiment.* A new idea may be ingrafted upon an old invention, be distinct from the conception which preceded it, and be an improvement. In such case it is patentable. The prior patentee cannot use it without the consent of the improver, and the latter cannot use the original invention without the consent of the former."

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* See

Herman v. *Youngstown Car Mfg. Co.*, 191 Fed. 579 (C. C. A. 6).
Century Electric Co. v. *Westinghouse Electric & Mfg. Co.*, 191 Fed. 350, 363 (C. C. A. 8).
Simplex Window Co. v. *Hauser Reversible Window Co. et al.*, 248 Fed. 919 (C. C. A. 8).
General Electric Co. v. *Cooper Hewitt Electric Co.*, 249 Fed. 61, 66 (C. C. A. 6) 1918.
Ashley et al. v. *Weeks-Numan Co.*, 220 Fed. 899, (C. C. A. 2) 1915.
Jay v. *Ireland & Matthews Mfg. Co.*, 280 Fed. 166, 173, D. C. E. D. Michigan, S. D. 1922.
Ries, et al. v. *Barth Mfg. Co.*, 136 Fed. 850, 853, 854 (C. C. A. 7).
General Electric Co. v. *Electric Controller*, 243 Fed. 188 (C. C. A. 6).

In *Cochrane* v. *Deener,* 94 U. S. 780, this Court (Mr. Justice Bradley) stated the rule of law as follows:

> "The defendants admit that the process has produced a revolution in the manufacture of flour; but they attribute that revolution to their improvements. It may be as they say, that it is greatly due to these. But it cannot be seriously denied that Cochrane's invention lies at the bottom of these improvements, is involved in them, and was itself capable of beneficial use, and was put to such use. It had all the elements and circumstances necessary for sustaining the patent, and cannot be appropriated by the defendants, even though supplemented by and enveloped in very important and material improvements of their own."

SIXTH DEFENSE.

This defense (R. B., pp. 81-90) is, in substance, that the claims in issue are not infringed because they are limited "to a process in which the froth *is formed by agitation,*" whereas respondent alleges that it uses a "process in which the froth is *not formed by agitation.*" The answer to this is that the froth in defendant's process *is* formed by agitation within the meaning of the claims in issue, and more specifically that the agitation present in defendant's process is operative to bring the metalliferous mineral particles into contact with the air bubbles (introduced through the bottoms of the cells) so that the mineral particles become attached to the air bubbles and are lifted by the air bubbles up through the pulp, and that these air bubbles so laden with mineral particles form a mineral-bearing froth above the surface of the pulp.

The statement of Respondent's Brief (p. 85) that in the defendant's process "the froth is formed without other agitation than the mere upward movement of the bubbles through the pulp" is not in accordance with the demonstrated facts. It was demonstrated that in defendant's flotation apparatus—Callow cells—there was actually present a very vigorous agitation with cross-currents, overlapping currents and shifting vortices.

Judge Peters, who saw the demonstrations, held, as we shall show, that defendant's froth is formed by agitation as required by the claims in issue.

Plaintiff erected in Boston * a small mill-size demonstration plant in which defendant's process was repeated in the presence of the trial Judge, and the conclusions of the trial Judge expressed in his opinion are based in part on his actual observations of those demonstrations. We quote from Judge Peters' decision his general description of the process as follows (R., Vol. I, p. 625):

> "The defendant's process is the Callow cell process, using a tank with a canvas or porous bottom through which air under pressure is forced into the pulp body contained in the tank. In this way myriads of small air bubbles are formed throughout the liquid mass and finally accumulate at the surface in the form of froth bearing the minute particles of mineral. *From actual observation of the process, as well as otherwise, I am convinced that the froth is formed by the agitation induced by the compressed air liberated in the mixture through the porous bottom;* that is to say, by the agitation in combination with the frothing agent which always has to be present. One is as important as the other."

This demonstration plant is fully described in the Record (pp. 125-129, Qs85-99). The Callow cells had glass sides so that the agitation within them was visible. The cells are shown in drawings, Plaintiff's Exhibits 12 and 13 (R., Vol. II, pp. 687-689), and the complete plant in Plaintiff's Exhibit 14 (R., Vol. II, p. 691). The drawings are described (Wilding, R., Vol. I, pp. 130-132, Qs108-125) as well as the blowers used to supply the compressed air (pp. 132, 133, Qs126-129). It appears that the volume of air delivered and the agitation caused thereby in these demonstrations were slightly less than in defendant's actual operations (R., pp. 153, 154, XQs249-252; pp. 162, 163, RDQs318-320).

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* Boston having been selected for the convenience of the Circuit Court of Appeals for the First Circuit when the case should have reached that court; although when that happened they declined repeated invitations to view the demonstrations.

It was stipulated that the ore used was defendant's ore, supplied by it (R., Vol. I, p. 133), and that the X-cake (alpha-naphthylamine) and lime used were also specimens received from the defendant. This ore was crushed, lime was added, the X-cake was dissolved, and defendant's operations were reproduced. Mr. Wilding generally describes this operation and the agitation produced in the cells (p. 138, Qs157, 158), and further describes the carrying on at the same time of the same operations in another of the glass-sided Callow cells with everything reproduced except that the ore was not present (pp. 138-139, Qs160-162). Here the vigorous agitation in the cell was plainly observable by reason of the removal of the obscuration caused by the opacity of the ore pulp. This vigorous agitation was plainly seen, with a general current of circulation across and up and across and down, overlapping currents, and irregularities and small vortices changing rapidly (p. 139, Qs163-166). These demonstrations were made in presence of Judge Peters.

An effort was made in behalf of the defendant to show that the very apparent vigorous agitation was the result of what defendant's witnesses called "dead space" at the deeper or outlet end of the cell, Taggart, R., Vol. I, p. 264, 265, Qs163-166; Yerxa, pp. 322, 323, Qs56-60), but it was shown, at the demonstrations before Judge Peters, by elimination of the so-called dead space, that this contention was groundless (Higgins, R., Vol. I, pp. 462, 463, Qs290-294).

Mr. Higgins also testified that these operations in the presence of the Court in the glass-sided Callow cell with the defendant's ore, lime and mineral-frothing agent, were in his opinion the same as those described in the stipulation as to defendant's operations (R., Vol. I, p. 464, Qs297, 298).

We here quote from Judge Peters' opinion (R., Vol. I, pp. 624, 625):

> "It remains to consider the position of the defendant that 'the claims are not infringed by the defendant's process because the claims were deliberately limited by the patentees to the agitation froth process, *i. e.*, a process in which the froth is formed by agitation, and the

defendant uses the pneumatic-flotation process in which the froth is not formed by agitation.'

The defendant's statement of this matter of defense, as above quoted, involves a characterization of the plaintiff's process as 'the agitation froth process' and the statement of fact that in the pneumatic process used by the defendant 'the froth is not formed by agitation.' If by that description of the plaintiff's process is meant one whereby the froth is formed by agitation as contrasted with a process where the froth is formed otherwise than by agitation, the characterization is apparently accurate and without ambiguity. The plaintiff's process comprises three essential parts, (1) mixing the powdered ore with water containing in solution a frothing agent, (2) agitating the mixture to form a froth, and (3) separating the froth. The process is undoubtedly an agitation froth process. The claim limits it to an agitation froth process, with no limitations on the kind of agitation.

Upon the evidence, however, *I am unable to agree with the statement that in the defendant's process,*—the alleged infringing process,—*the froth is not formed by agitation.* The evidence of the process, its exemplification by the experiments in Boston for the benefit of the Court, and common-sense reasoning from known facts, *point conclusively to the contrary.*"

Then follows Judge Peters' description of the Callow cell operations above quoted, including a further statement of his conclusions, here repeated, and his further discussion of this defense (R., Vol. I, p. 625, 626):

"*From actual observation of the process, as well as otherwise, I am convinced that the froth is formed by the agitation induced by the compressed air liberated in the mixture through the porous bottom;* that is to say, by the agitation in combination with the frothing agent which always has to be present. One is as important as the other.

In the trial of the case this particular defense of non-infringement appeared to be based not so much on an agitation process, as it was on mechanical agitation as against pneumatic agitation. It can hardly be claimed that there is not agitation in both processes. The me-

chanical agitation is apparently more violent, but may not be more pervasive than the agitation caused by compressed air. At least each is effective for the purpose and I think it cannot be successfully claimed that frothing would take place without one or the other.

Patent No. 835,120, called the first patent above, being the patent that required the use of oil, is the patent that features the mechanical agitation, which was required to be of considerable intensity and duration to disseminate the minute amount of oil throughout the mixture. In any soluble frothing agent process less agitation would be required *as the agent tends to disseminate itself.* The agitation in the defendant's process is caused by compressed air let into the pulp. The question is simply whether the claims in the patent in suit are broad enough to cover that method of agitation. It would seem that the question answers itself, because the language is 'agitating the mixture to form a froth.' I can see no reason why the language should not receive its ordinary, natural meaning and be construed like the language of any contract. Its terms are perfectly plain and unambiguous."

Judge Peters then cites authorities in support of his construction of the language of the claims in issue and then gives a further statement of his conclusions as to this sixth defense (R., Vol. I, p. 627):

"I can find no satisfactory foundation for the defendant's theory that the words in the claims, 'agitating the mixture to form a froth,' have any special or recognized significance to one skilled in the art, or that the words carry back to the agitation froth process of patent No. 835,120, and exclude other froth flotation processes.

Indeed, this construction is negatived by the very language of the defendant in stating this 'seventh defense' [now sixth defense], where it is said that the claims (1 and 2) were limited to 'the agitation-froth process, *i. e., a process in which the froth is formed by agitation.*' That is what I find it to be, that and nothing less, and that, by the plain meaning of the language, covers agitation to form the froth whether caused by stirring with a paddle or stirring with compressed air. In both cases air is introduced into the mixture, and has to be, to make it froth. As was said by Prof. Taggart, expert witness for defendant, in an article he wrote on the sub-

ject before he was connected with the case, *'the only difference is in the method of introducing air.'* *

I find that the defendant's process in this respect also is fairly covered by the plaintiff's claims, and is an infringement."

These conclusions as to the facts and the law, undisturbed by the opinion immediately below, which did not discuss the question of infringement, would seem to leave no further question for consideration; but Respondent's Brief injects into the sixth defense one of the disproved theories of defendant's expert Professor Taggart, in calling this operation of the process in the defendant's Callow cells (R. B., p. 81) "the pneumatic bubble column flotation process."

The bubble-column theory. This theory, as put forth by Professor Taggart, is that in defendant's Callow cell there is no attachment in the pulp of the metalliferous mineral particles to the air bubbles, that mineral and gangue particles are indifferently entangled with the bubbles as they rise out of the pulp, and that the separation is effected by a differential falling action in the froth itself after it is formed, the metalliferous mineral particles falling less rapidly through the froth than the gangue does in relation to the uprising bubbles. This is contradicted by two of the patents under which defendant is licensed, the Callow patent for the Callow cell and the Towne & Flinn patent (which is the so-called bubble column patent) as we shall show. It is also contradicted by Professor Taggart himself in a published description written before he became connected with flotation litigation. This article was published by him in 1916 in collaboration with Professor Beach, but was apparently written by Taggart (Taggart, R., Vol. I, pp. 301, 302, XQs371-372). The following is quoted from the article (R., Vol. I, pp. 302, 303, XQs376, 377):

"Pneumatic Froth Process.

"Sulphide [metalliferous mineral] and gangue minerals mixed with water and oil, with or without acid,

* The relevant parts of Taggart's published statement here referred to and partly quoted by Judge Peters appear in full on this and the following page.

are run into a tank with a porous bottom through which air is forced. The air bubbles rise to the surface with a coating of solid particles, preponderantly sulphide, while the gangue particles sink.

"The principles involved in this method are the same as explained in the agitation-froth process. *The only difference is in the method of introducing air.* The result of this difference is that the bubbles in the pulp are much larger than in the agitation-froth method. They arrive at the surface less heavily loaded in proportion to their weight. The bubble films are therefore less viscous and the froth less persistent."

And from another part of this article the following may be quoted (R., Vol. I, pp. 303, 304, XQs378-379):

> "But the *agitation of the pulp in the mechanical and pneumatic froth processes * * * are sufficient,* in their [the authors'] opinion, to *bring every sulphide particle into contact with a bubble film.* Once in contact, the preferential adhesion of the contaminated layer to a sulphide surface in the presence of water is sufficient to account for *the persistent attachment of the sulphides to the bubble films.*"

This article was a truthful statement of the facts and was written at a time when the witness held no "brief" for either side.

This is the article referred to by Judge Peters in the last above quotation from his opinion (*supra* pp. 53, 54).

Professor Taggart in putting forward his bubble-column theory in the present case says (R., Vol. I, p. 258):

> "in the pneumatic process, in the first place, there is no attachment of particles to the bubble in the pulp,"

This not only contradicts his own statement as to "the persistent attachment of the sulphides to the bubble-films" but is also contradicted in the so-called bubble-column patent to Towne & Flinn, No. 1,295,817, issued February 25, 1919, Defendant's Exhibit 127, under which, as stated, defendant is

licensed. Claim 1 of this patent (R., Vol. II, p. 1230) is as follows:

> "An ore-concentration process, which comprises the operations of charging a vessel with a flowing pulp consisting of crushed ore, water and a froth-producing and mineral-selecting agent, introducing a gas through a fine-texture porous medium into said ore pulp and forming *bubbles to which certain mineral particles of the ore adhere as said bubbles rise through the pulp*, causing said mineral-bearing bubbles to form a column of bubbles above the pulp, and separating the mineral carried by the bubbles in the upper part of the bubble column from the remainder of the ore."

Many other similar statements appear in that patent and in its voluminous file-wrapper and contents, Defendant's Exhibit 143 (in evidence, R., Vol. I, p. 576, physical exhibit) but the above quotation will be sufficient to make it quite clear that the patentees asserted that in the pulp the metalliferous mineral particles adhered to the air bubbles.

Taggart's present theory is also contradicted by the Callow patent for the Callow cell, No. 1,329,334, under which, as stated, the defendant is also licensed. It illustrates a Callow pneumatic cell of the same general type as that employed by the defendant, and clearly points out that the bubbles in the pulp unite with the metalliferous mineral particles there. This is stated, for example, in claim 15, wherein the language is (R., Vol. II, p. 1237, Spec., p. 5, lines 21-24):

> "causing the said bubbles to unite with the metalliferous particles and carrying them to the surface of the pulp mass,"

The file-wrapper and contents of this Callow cell patent is also in evidence (Pltf.'s Ex. 105, R., Vol. II, pp. 757-843) and as filed the specification made it quite clear that the process involved agitation to form a froth, quite contrary to the present theories of the respondent. The description of the operation that takes place in the Callow cell included the following statement (p. 762):

> "the *agitation of the pulp by air,* gas or vapor, which is admitted into the pulp in fine streams and under, preferably, substantially low pressure and which *acts upon the fluid contents of the pulp to cause the formation of a foam* or sud which successively rises to the surface of the pulp and overflows into an appropriate launder."

This description of the agitation to form a froth was further particularized as follows (p. 764):

> "air, gas or vapor, under pressure, in the cell below [air chamber], will escape in innumerable fine streams, or jets, this being for the purpose of *both aerating and agitating the pulp* in the compartment above [pulp chamber], the compressed air, gas, or vapor, becoming the medium of (1) aerating or charging the pulp with a desired volume of air, gas, or vapor, and (2) it likewise induces and *maintains an agitation or ebullition* of the pulp and the oily constituents thereof *and produces a froth* composed of bubbles of air, gas or vapor having an envelope or covering of oily matter, to which the mineral particles in the pulp have an affinity and will attach."

Another Callow patent under which defendant is licensed, No. 1,141,377 of June 1, 1915, Plaintiff's Exhibit 108, contains statements as to the *substantial equivalency of pneumatic agitation and mechanical agitation.* We will merely repeat the most striking part thereof (R., Vol. II, p. 855, Spec., p. 1, lines 70-77):

> "The compressed air thus becomes the medium of (1) fully aerating or charging the pulp with the desired volume of air, and (2) it likewise *induces and maintains that agitation of the pulp which heretofore was obtained by the mechanical propellers and stirrers before alluded to.*"

The apparatus shown and described in this patent was undoubtedly the precursor of the Callow cell. It lacks only the inclined bottom and single large vessel which tend to intensify the agitation.

Another Callow patent under which defendant is licensed, No. 1,125,897, Plaintiff's Exhibit 107, repeats the language just above quoted from patent No. 1,141,377 (R., Vol. II, p. 850, Spec., p. 1, lines 53-59), in describing the operation of the apparatus disclosed in Callow patent No. 1,141,377.

These last two patents were issued before the theories now put forth by Professor Taggart were evolved, and, like his own article, were free from the bias of interest and of controversy and, moreover, the facts stated in them were in the instant case actually demonstrated in the presence of the trial Court below.

The bubble-column theory of Professor Taggart is not only thus contradicted by himself and by the earlier patents under which defendant attempts to justify its infringing acts, but it is palpably and baldly erroneous. We will merely call attention, without discussion, to the evidence establishing this fact (Higgins, R., Vol. I, pp. 465, 466, Qs299-306; p. 474, Qs357-359).

Respondent's Brief appears to rely upon the decision of the Circuit Court of Appeals for the Third Circuit for argument supporting the assertion that agitation to form a froth does not occur in the Callow cell, and that in the Callow cell there is a "mere upward movement of the bubbles through the pulp" (R. B., p. 85). The quotations (R. B., pp. 86-89) are largely from the discussion in that opinion as to the kind of agitation which was required by the process of patent No. 835,120, wherein a very small quantity of an undissolved oily substance had to be disseminated through an ore pulp so as to preferentially coat the metalliferous mineral particles therein and then those so coated particles had to be brought into contact with air bubbles. There was unquestionably a difference of opinion among the Judges in that court as to the degree of agitation that was necessary for that purpose in the process of that patent No. 835,120, but the dissenting opinion of Judge Buffington did not go beyond that patent.

Again in that case the agitation in the Callow cell was preceded by agitation in three successive pieces of apparatus which were held in the majority opinion to themselves produce an

agitation sufficient to form the froth, whereas the defendant here omits all preliminary agitating apparatus. It is to be noted, however, that even in the discussion of the agitation of patent No. 835,120 and of this apparatus, Judge Woolley said (244 Fed. at 766):

> "We see no difference between the blow of a paddle and the blow of a blast of air as means to produce agitation."

and further said (*ib*)

> "When the critical quantity of the oil is used and fomentation is produced by agitation, which in degree of violence and in duration is substantially that of the patent, clearly it is indifferent whether it is attained by mechanical or other means, for the patent deals with agitation as a means of developing the discovery, not with means for developing agitation."

Judge Woolley in discussing this question of agitation as related to the patent here in suit No. 962,678, said (244 Fed. at 773):

> "The agitation is to be thorough, but in the same connection the *means for bringing this about is described in terms that are wide and inclusive.* The air or other gas is to be 'liberated in, generated in, or effectively introduced into, the mixture,' in order that the ore particles may come into contact with the gas and as a result may float to the surface in the form of a froth or scum which can be separated afterward by any known means. The object of introducing the air or other gas into the mixture is such agitation of the pulp as will produce the desired froth, but *the claims are not confined to a particular device or a particular degree of agitation.* But of course, the agitation must be thorough and it must be effective, these being matters for experiment but always with the ultimate object of bringing the sulphid particles to the surface and holding them there in the grasp of a froth."

As to the question of infringement of the patent here in suit No. 962,678, Judge Woolley finally said (244 Fed. at 774):

> "* * * The real question upon this patent also is the question of infringement, and here as well as there the decision turns upon the kind and degree of agitation employed by the defendant. We need not dwell upon the subject, for as the defendant used both processes conjointly it is evident that what has been said about the infringing agitation in the oil process [of patent 835,120] must also apply to the same agitation when considered in reference to the second process [of 962,678]. *There is this difference,* however; as pointed out above, *the agitation of the second process* [patent] *is so described as to cover expressly a wider range of means and degree* than is expressly covered by the first process [patent], and therefore needs less aid, *if any,* from the doctrine of equivalents. For the reasons given in discussing the oil patent, we think the defendant's practices there described infringe also the process now under consideration."

As to the *dicta* of Judge Woolley quoted in Respondent's Brief at page 86 and again on page 88 and finally conceded to be *dicta* at page 90, Judge Peters said (R., Vol. I, pp. 627, 628):

> "The Court certainly did use some expressions which indicated that it would not have considered the agitation of the Callow cells alone the equivalent of the violent agitation of the first patent (Patent 835,120 and not the patent in suit). But it did not pass upon the question whether the use of the Callow cell alone without other agitation would be an infringement of either patent."

Thus Judge Peters decided this question as the result of his own study and personal observation, and not under compulsion of the rule of comity.

In conclusion upon the question of infringement, it is submitted that the process of the patent in suit is an invention of prime importance and is pioneer in character and has enor-

monsly created and conserved wealth and materially advanced the arts, and that its claims are entitled to liberal construction under the rule of construction stated in *Eibel Process Co.* v. *Minnesota & Ontario Paper Co.*, 261 U. S. 45, 63, where this Court said:

> "In administering the Patent Law the court first looks into the art, to find what the real merit of the alleged discovery or invention is, and whether it has advanced the art substantially; and if it has done so, the court is liberal in its construction of the patent, to secure to the inventor the reward he deserves."

CONCLUSION.

In conclusion of the entire case we submit that all the defenses fail in the proofs and that the decree of the Circuit Court of Appeals for the First Circuit should be reversed and the decree of the District Court affirmed and the case remanded for further proceedings in accordance with that decree.

New York, N. Y.
January 2, 1930.

Respectfully submitted,

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MAY 10 1929
CHARLES ELMORE CROPLEY
CLERK

Supreme Court of the United States

OCTOBER TERM, 1928.

No. ~~851~~ 71

MINERALS SEPARATION NORTH AMERICAN CORPORATION,

Petitioner,

against

MAGMA COPPER COMPANY,

Respondent.

BRIEF FOR RESPONDENT IN OPPOSITION TO PETITION FOR WRIT OF CERTIORARI.

WILLIAM H. DAVIS,
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Supreme Court of the United States

OCTOBER TERM, 1928.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner,

vs.

MAGMA COPPER COMPANY,
Respondent.

RIEF FOR RESPONDENT IN OPPOSITION TO PETITION FOR WRIT OF CERTIORARI.

While it is true that on January 10, 1929, the Court f Appeals for the First Circuit held invalid claims 1 nd 2 of petitioner's patent 962,678 which claims velve years previously, on May 24, 1917, had been held alid by the Court of Appeals for the Third Circuit; et we do not believe the litigation demands or warrants he attention of this Court, for two reasons:

1. The present conclusion of invalidity arises from **cts**; established in the case at bar but unknown to the udges in the Third Circuit, and constituting direct anticipation of the supposed invention.

2. The naked question whether the patent is valid or nvalid is now of **no general interest or importance.**

I.

The present conclusion of invalidity arises from facts; established in the case at bar but unknown to the Judges in the Third Circuit, and constituting direct anticipation of the supposed invention.

No question of law is involved; nor is the sometimes difficult question of invention, as distinguished from mechanical skill, presented. If the facts are as the Court of Appeals for the First Circuit found them to be, direct anticipation is established.

The essential facts are:

(1) The subject-matter of petitioner's patent 962,678 is the use of a "soluble mineral-frothing agent" in the agitation-froth process of petitioner's earlier patent 835,120. The "soluble mineral-frothing agents" named in patent 962,678 include "amyl acetate and other esters; phenol and its homologues; benzoic, valerianic and lactic acids, acetones and other ketones such as camphor" (R., II, 2; Pat., p. 1, lines 33-36).

(2) It was shown by the evidence, and found as a matter of fact by the Court of Appeals in the instant case, that these substances named in the second patent 962,678 as "soluble mineral-frothing agents" are in fact oils, oily substances, and/or fatty acids; and that these substances were among the "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" (R., III, 178; Pat. 835,120, p. 1, lines 12-15), already known at the date of, and already available for use as flotation agents in, the froth flotation process of the earlier patent 835,120.

For instance, phenol, one of the so-called "soluble mineral-frothing agents" named in patent 962,678, the Court of Appeals of the First Circuit finds to be "specifically named in the prior art patent of Cattermole

777,274 and * * * among the oils or oily liquids of patent No. 835,120" (Opinion, R. I., 953), and the Court there said:

> "Phenol being among the oils or oily liquids of patent No. 835,120 and that patent having disclosed that by reducing the quantity used to a fraction of one per cent. on the weight of the ore and by vigorously agitating the pulp, the agent would effect the process of that patent, it is apparent that a clear disclosure anticipating the patent in suit is shown, for phenol in the quantity used in the process of that patent is wholly dissolved in water."

In like manner it was shown that amyl acetate and amyl alcohol are well known oils of commerce having preferential affinity for metalliferous matter and "undoubtedly oils of the prior art" (Opinion, R., I, 953); and that valerianic acid "is a fatty acid of the prior art patents Nos. 835,120 and 777,274" (same page).

These facts were not established in the Miami case in the Third Circuit. That is clear from the opinion of the District Court and from the opinion of the Court of Appeals.

In the District Court (see *Minerals Separation* vs. *Miami Copper Co.*, 237 Fed., 609, at pp. 634-636), Judge Bradford said* (pp. 635-6):

> "In the process of the second patent in suit, **no oil, fatty acid, or oily substance is introduced** into the mixture.
>
> * * * * * * *

*There were three patents involved in the Miami case—(1) the agitation froth patent 835,120; (2) the patent here sued on, 962,678; and (3) the Greenway patent 1,099,699. Judge Bradford's entire discussion of the patent 962,678 is found on pages 634-636.

> "The novelty of this invention is to be found • • • in the fact that a mineral-frothing agent as the means of separating the metallic particles from the gangue **is substituted for** the oil, fatty acid or other oily substance essential to the process of the first patent in suit." (Emphasis ours.)

In the instant case it was, on the contrary, proved that the "soluble mineral-frothing agents" named in patent 962,678 are in fact oils, fatty acids or oily substances; and that they are not substituted for, but are chosen from among, the "oils, fatty acids or other substances which have a preferential affinity for metalliferous matter over gangue" of patent 835,120.

The Court of Appeals of the Third Circuit in the *Miami* case said, in the majority opinion (244 Fed., 773):

> "The difference between the two patents may be shortly stated to be this: The first process rests upon the use in very small quantity of **an oily substance that does not dissolve in water,** coupled with agitation of the pulp, and this succeeds in producing a special froth that is remarkably effective in recovering the minute particles of ore. The second process **does not employ oil,** or an undissolvable substance; on the contrary, the 'mineral-frothing agent' must be in solution, and *ex vi termini* must therefore be dissolvable. The specification disclaims the use of so large a quantity that part of it remains undissolved." (Emphasis ours.)

But in the instant case it was proved, and the Court found, that among the oily substances of the first patent (835,120) are those that do dissolve in the pulp water; that the substances named in the second patent (962,678) are oils and oily substances already known to be avail-

able for use in the process of the first patent, and that the supposed difference between the two patents does not, as a matter of fact, exist.

II.

The naked question whether the patent is valid or invalid is of no general interest or importance.

The patent expired on June 28, 1927.

Moreover, during the ten years from the date of the decision in the Third Circuit on May 24, 1917, to the date of expiration of the patent on June 28, 1927 petitioner enjoyed the benefit of that favorable decision, and the great bulk of the ore treated in this country was under its license.*

Paragraph IX of the petition shows that in addition to this suit there are but two other suits for infringement. These suits were filed in November 1923 against National Lead Company and its subsidiary St. Louis Smelting and Refining Company. The validity of the patent is, therefore, a question that interests only the petitioner, the respondent and the National Lead Company.

The suit against the National Lead Company is pending in the Third Circuit, and there is no reason why it should not have been, or why it should not now be, pressed to final determination without the interposition of this Court. If petitioner believes that it can establish before the Courts of the Third Circuit that the so-called "soluble mineral-frothing agents" of patent 962,678 are not in fact among the already known oils, oily substances and fatty acids having a preferential affinity for metalli-

*In 1923, when the instant case was on trial, the yearly aggregate of licensed tonnage was 169,041,149 tons (Pltf.'s Exs. 18 and 19; R., II, 83-93).

ferous matter over gangue, of patent 835,120, then it ought to proceed with the litigation against the National Lead Company.

The respondent here by weight of evidence has established the contrary fact. It seems to us that in this litigation we have not yet reached any conflicting decisions of two Circuit Courts of Appeals on the same matter; and will not unless and until the Courts of the Third Circuit make a different finding of fact on the same evidence; or arrive at a different conclusion of validity (if that is conceivable) on the same findings of fact.

FURTHER COMMENTS ON THE PETITION AND ON PETITIONER'S BRIEF.

We think a very wrong impression of the nature and status of this litigation might be derived from some of the things said and suggested in the petition and in petitioner's brief. We therefore add the following comments:

(1) We think that the quotations from the opinion of the Court of Appeals of the First Circuit, printed on page 3 of the petition, might easily be misleading as to what the Court of Appeals meant when it said "We, therefore, decline to follow the decision in the *Miami* case."

In the *Miami* case the agent used by the defendant was partly soluble and partly insoluble. Petitioner there urged that this partly soluble and partly insoluble agent infringed both patent 835,120 and patent 962,678, and the Court of Appeals of the Third Circuit so held. The argument was that in so far as the agent contained an insoluble substance it infringed patent 835,120, and in so far as it contained a soluble substance it infringed

the later patent 962,678. But it was proved in the case at bar, and the Court of Appeals of the First Circuit found as matter of fact, that in order to be effective at all in the agitation-froth process of patent 835,120, the agent used **must be partly soluble.** On this subject the Court of Appeals said (R., I, 955):

> "Furthermore, a study of the testimony in the case and the reason of the thing have convinced us that oleic acid (the agent specifically named in patent No. 835,120 and declared to be immiscible in the patent in suit) and all the mineral-frothing agents that have been used in these processes, in the limited amount prescribed of a fraction of one per cent. on the ore, are soluble to some extent because you can not get froth flotation unless there is present a constituent soluble to an extent sufficient to produce the requisite froth or scum, and the fact that oleic acid, when so used, produces the requisite froth or scum."

This established fact, that all the mineral-frothing agents of patent 835,120 are partly soluble, glaringly disclosed the fallacy of petitioner's contention, and of the Court's conclusion, in the *Miami* case, that organic compounds partly insoluble and partly soluble in water are within the scope of the second patent 962,678. That is the contention of which the Court of Appeals in the instant case said (R., I, 948):

> "* * * and apparently they have obtained a decision to that effect in Miami Copper Co. vs. Minerals Separation, Ltd., 244 Fed., 752, * * * We do not now stop to consider the soundness of this contention and holding, for it is not directly involved in this case, although it will be considered later."

Moreover, as the Court of Appeals pointed out (R., I, 947), patent 962,678 says (R., II, 3, lines 68, et seq.):

> "It is well known that certain of the organic substances we have referred to are not soluble in water in all proportions and that if used in excess might partly remain insoluble in the acidified water and might become mechanically affixed to the metalliferous particles of the ore. **We disclaim any such use of these substances and only claim them in such amount as will enable them to dissolve in the acidified water.**"

In view of the established fact that all the organic mineral-frothing agents of patent 835,120 are partly soluble, plus this explicit disclaimer in the patent 962,678, the Court of Appeals in the instant case reverted to petitioner's contention that a partly soluble mineral-frothing agent infringes patent 962,678 and said (R., I, pp. 955-6):

> "In the Miami Copper case, *supra*, the litigation involved both patent No. 835,120 and the patent here in suit No. 962,678. The agent employed by the defendant in its infringing process was partly soluble and partly insoluble, and the use of such an agent in a fraction of one per cent. on the ore was held to infringe both patents on the ground that it was a conjoint use of both. While such use was plainly within the scope of the disclosure of the first patent (No. 835,120) and in infringement of it, it was not within the scope and an infringement of the second patent, for even assuming that the second patent is valid, its scope, as previously pointed out, is limited to the use of an agent that is wholly in solution in water. This being so, the use of the agent there

> employed was not within the scope and an infringement of the second patent. We, therefore, decline to follow the decision in the Miami case."

It was on this question, not directly involved in this case, that the Court of Appeals of the First Circuit expressly declined to follow the decision in the *Miami* case. On the direct issues in the instant case the evidence was such, in comparison with the issues and evidence in the *Miami* case, that no real conflict existed—beyond the naked circumstance that one Court, on proof of a certain state of facts, held the patent valid in 1917 and the other Court, on a different state of facts, held the patent invalid in 1929.

(2) Petitioner asserts that the Court of Appeals in the instant case has not given proper effect to applicable decisions of this Court.

The suggestion is based upon that part of the opinion of the Court of Appeals (R., I, 950-952) where the Court discusses the opinion of this Court in the *Butte and Superior* case and applies the reasoning of this Court by analogy to the question at issue in the instant case.

Petitioner's whole contention that the process of patent 962,678 differs from the process of patent 835,120 may be thought of as an elaboration of the assertion in patent 962,678 (R., II, 3; Pat., p. 2, lines 58-62) that

> "In the frothing processes hitherto known the substances used to secure a formation of a mineral-bearing froth has been oil or an oily liquid immiscible in water."

In other words, petitioner has contended that the mineral-frothing agents—the "oils, fatty acids, or other substances which have a preferential affinity for metalli-

ferous matter over gangue"—of patent 835,120 exclude substances which are either wholly or in part soluble in water. No such statement is found in the specification of patent 835,120 and, as we have seen, the Court of Appeals in the instant case held as matter of fact on the evidence submitted that all of the mineral-frothing agents of patent 835,120 are of necessity partially soluble in water. And the Court further held that the knowledge of the art at the date of patent 835,120 included the wholly soluble substances named in patent 962,678.

Considering this attempt to exclude from the disclosure of patent 835,120 known substances which are not excluded therefrom in terms, the Court of Appeals of the First Circuit in the instant case referred to an analogous attempt, on the part of petitioner, to limit the disclosure of patent 835,120 in the *Butte & Superior* case. In that case petitioner attempted to exclude from the disclosure of patent 835,120 all non-frothing oils. But this Court held that there was no such limitation expressed in the specification of patent 835,120, and that

> "To give such a construction to the patent would subordinate the clear description contained in it of what are oils of the process, to an implied and vague description and classification which would leave the whole subject again at large, * * *" (250 U. S., 336 at 350).

In like manner, and for like reasons, it is impossible now to exclude from the disclosure of patent 835,120 substances which are soluble in water, when the disclosure contains no such limitation and when it is now found, as a matter of fact, that all the oils, oily substances and fatty acids of patent 835,120 are and must be partially soluble in water.

If this Court will note the extraordinary circumstance that the petitioner's attempt, in the *Butte & Superior*

case, was to exclude "**immiscible**" substances from patent 835,120, whereas its present attempt is to exclude from that disclosure **soluble** substances and to include **only immiscible** substances, it will be seen how well justified was the Court of Appeals of the First Circuit in referring to the decision of this Court in the *Butte & Superior* case to support its conclusions in the instant case. The substances which, in the *Butte & Superior* case, petitioner urged to be exclusively the oils of patent 835,120 were, on petitioner's own showing, soluble substances in whole or in part. This Court not only found that such soluble substances were the oils of patent 835,120 but that also "non-frothing oils [immiscible, if such there are] having the required affinity" were included among the oils of patent 835,120. Since partially soluble oils were included by this Court, on petitioner's own urging, as pre-eminently the oils of patent 835,120, the Court of Appeals of the First Circuit was certainly justified in saying that (R., I, 952):

> "This holding is a complete refutation of the statement in the patent in suit (No. 962,678) where it says that the frothing agents of the prior art are only such as are immiscible in water, to wit:
>
> > 'In the frothing processes hitherto known the substances used to secure the formation of a mineral-bearing froth has been oil or an oily liquid immiscible with water.'"

(3) In petitioner's brief (pp. 7, et seq.) it is urged that the processes of the two patents "are unlike in regard to the kind of frothing agent employed and in regard to its mode of operation in producing the mineral-bearing froth," and counsel say that (brief, p. 8):

> "The process of patent No. 962,678 proceeded **without any coating** of the metalliferous particles,

> which coating was of the essence of the process of patent No. 835,120''

and again (p. 12):

> ''An agent capable of existing 'in solution' in the water of the pulp and thereby on agitation achieving mineral-froth formation and ore concentration, is and **must be** a different physical thing from an agent capable of existing as a coating on the metalliferous matter under the water of the pulp and thereby on agitation achieving mineral-froth formation and ore concentration.''

and again (p. 13):

> ''An agent that dissolved in the water **could not exist as a coating** on anything in that water.'' (Emphasis ours.)

To a person unfamiliar with the subject, these very positive assertions that a substance which dissolves in water cannot coat particles immersed in that water might easily be misleading. The assertion may seem convincing unless the reader is acquainted with the phenomenon of **adsorption from solution.** The fact is, as was established in the instant case and found by the Court of Appeals, that the mineral particles are in fact coated with the dissolved flotation agent by adsorption from the solution; just as the particles of a dyed fabric are coated with the dissolved dye adsorbed from the dyeing solution (R., I, 255, 361). On that subject the Court of Appeals of the First Circuit found the facts to be as follows (R., I, 954):

> ''Then again, the disclosure of these two prior art patents,—that agents having a preferential affinity

for metalliferous matter coat the mineral particles with a slight film,—is supported by the adsorption theory presented in evidence through defendant's witness Taggart, that such agents, though in solution, will attach themselves to and slightly coat the mineral particles.

"The plaintiffs undertook to refute the disclosure of the New Zealand* and the United States patents, —that a soluble agent would coat the metalliferous particles and on agitation produce a froth or scum,— by an experiment which they made; but the experiment amounted to nothing in the absence of the deduction drawn therefrom by the plaintiffs' expert witness, which deduction was contradicted and substantially refuted by the testimony of the defendant's witness."

(4) Asserting that patent 962,678 represents a great advance over patent 835,120, the petition avers (Par. VIII, p. 4) that **porphyry copper ores were not** amenable to concentration by any flotation process prior to the alleged invention of patent 962,678.

That contention was urged before the Court of Appeals in the instant case, and rejected; the Court finding that the process of patent 962,678 is the same as that of patent 835,120. Among the things that respondent's counsel called to the attention of the Court of Appeals, and now calls to the attention of this Court, to refute this assertion of substantial advance resulting in the flotation for the first time of porphyry ores, is the fact that in the *Miami* case **petitioner urged,** and the District Court found, **that porphyry copper ores were successfully floated by the**

*New Zealand patent No. 19,633 of 1905 (R., III, pp. 182-197) corresponds to U. S. patent No. 835,120, and in addition contains the full disclosure of Cattermole U. S. patents Nos. 777,273 and 777,274.

process of patent 835,120. In the *Miami* case Judge Bradford said (237 Fed., 618):

> "A great advance in the art of ore concentration has resulted from the process of **the first patent** in suit [835,120] in the efficient recovery of slimes. With the use of **that process** ore may be so finely ground as to insure the thorough separation of the metallic particles and gangue, and great savings effected. The profit so saved in a single year from the output of the principal **porphyry copper mines**, including the defendant's, has been estimated by one of the expert witnesses as more than $17,000,000." (Bracketed portion and emphasis ours.)

Furthermore, the only remaining litigation, that against National Lead Company and its subsidiary St. Louis Smelting and Refining Company, involves only flotation of lead and/or zinc ores.

(5) The cases in this Court, in the Courts of the Third Circuit, and in the Courts of the First Circuit, are listed in the petition (index page). A convenient chronological summary of the cases in this Court and in the Third Circuit is found in the opinion of the Court of Appeals for the Third Circuit (244 Fed., at p. 757). Petitioner's brief says (p. 14): "* * * the *Miami* case was before this Court" in the *Butte and Superior* case, and argues that it was approved by this Court because it is mentioned in a footnote listing the cases in which patent 835,120 has been involved. But patent 962,678 was not involved in the *Butte and Superior* case, nor was that case in any sense a review by this Court of any issues raised or decided in the *Miami* case. One might equally well argue that this Court approved the dissenting opin-

ion of Judge Buffington in the *Miami* case, since that, too, is specifically mentioned in the margin note.

It is submitted that the petition should be denied.

WILLIAM H. DAVIS,
MERTON W. SAGE,
Counsel for Respondent.

New York, N. Y., May 3, 1929.

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CHARLES ELMORE

Supreme Court of the United States

OCTOBER TERM, 1929.

No. 71.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner-Plaintiff,

vs.

MAGMA COPPER COMPANY,
Respondent-Defendant.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE FIRST CIRCUIT.

BRIEF FOR RESPONDENT-DEFENDANT.

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Supreme Court of the United States

OCTOBER TERM, 1929.

No. 71.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner-Plaintiff,

vs.

MAGMA COPPER COMPANY,
Respondent-Defendant.

BRIEF FOR RESPONDENT
(Defendant Below).

Jurisdiction of the Court.

This case comes from the Circuit Court of Appeals of the First Circuit to this Court on a writ of certiorari granted May 20, 1929, on petition of plaintiff* below because of conflict as to anticipation of patent 962,678 (claims 1 and 2) by plaintiff's earlier patent 835,120; between the Circuit Court of Appeals of the First Circuit which, on January 10, 1929, held the patent invalid

*In this brief petitioner will be referred to as plaintiff, and respondent as defendant, as in the courts below. Emphasis is supplied by counsel unless otherwise stated.

(Opinion, R., I, 639, 30 Fed. [2d], 67), and the Circuit Court of Appeals of the Third Circuit which, on May 24, **1917,*** held the claims valid (244 Fed., 752).

Brief Statement of the Case.

The complaint, filed January 9, 1920, asserted infringement of plaintiff's patents 835,120** (the so-called *agitation froth patent*) and 962,678 (the so-called *soluble frothing agent patent*). By stipulated order of court filed September 28, 1922, the complaint was dismissed as to patent 835,120 and an amended bill filed limiting the charge of infringement to patent 962,678. At the trial the charge of infringement was restricted to claims 1 and 2 of patent 962,678.

The defenses presented at the trial are invalidity and non-infringement.

The patent is asserted to be invalid:

(1) Because its disclosure is anticipated in the agitation froth patent 835,120.

This is the defense as to which conflict has arisen. The other defenses were not presented to the Court of Appeals of the Third Circuit and they were not passed on by the Court of Appeals of the First Circuit, which sustained the first defense but did not consider the other defenses.

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*That was before the decision of this Court in *Minerals Separation, Ltd.*, vs. *Butte & Superior Mining Co.*, 250 U. S., 336. The importance of this sequence of decisions is pointed out hereinafter.

**This is the much litigated patent that has been before this Court twice. It was sustained in *Minerals Separation, Ltd., et al.*, vs. *Hyde*, decided December 11, 1916, 242 U. S., 261, and the scope of its disclosure and claims was passed upon in *Minerals Separation, Ltd., et al.*, vs. *Butte & Superior Mining Co.*, 250 U. S., 336 (June 2, 1919).

(2) Because there is prior invention and prior patenting of the subject matter, in the United States patent to Sulman 955,012 (R., II, 1058, et seq., and *post*, p. 59).

(3) Because the patentees Sulman, Greenway and Higgins were not joint inventors, the alleged invention having been made by Higgins and subsequently communicated by him to Sulman and Greenway (*post*, p. 63).

(4) Because the claims sued on (claims 1 and 2) embrace the use of soluble mineral-frothing agents in any kind of pulp, whether acid, neutral or alkaline; whereas the patentees' alleged discovery, and the disclosure of the specification, is limited to the use of soluble mineral-frothing agents in an acid pulp (*post*, p. 69).

On the issue of infringement the defenses are:

(1) Defendant does not use the acidified pulp to which the alleged discovery and the disclosure are limited, and to which claims 1 and 2 must be limited to save them from invalidity (*post*, p. 69).

(2) Defendant does not use a process in which the froth is formed by agitation, to which claims 1 and 2 are expressly limited (*post*, p. 81).

Plaintiff's statement of the case is erroneous.

1. The assertion of plaintiff's counsel (brief, p. 1) that in reaching the conclusion that claims 1 and 2 of patent 962,678 are not anticipated by patent 835,120:

> "The Circuit Court of Appeals for the Third Circuit in the said *Miami* case had followed this Court in this Court's elucidation in *Minerals Separation*,

> *Ltd.*, vs. *Hyde*, 242 U. S., 261, of the invention of plaintiff's earlier patent aforesaid No. 835,120 (an elucidation later confirmed by this Court in *Minerals Separation, Ltd.*, vs. *Butte & Superior Mining Co.*, 250 U. S., 336),"

is not true.

The *Miami Case* was decided May 24, 1917, after the decision by this Court of the *Hyde Case* and *before* the decision by this Court of the *Butte Case*. The decisions of the District Court and of the Court of Appeals in the Third Circuit in the *Miami Case*, sustaining patent 962,678, were expressly based on the *belief* (disproved in the instant case) that the soluble mineral-frothing agents of patent 962,678, *are not oils or oily substances*, and were not, therefore, embraced within the oils, fatty acids or other substances having a preferential affinity for metalliferous matter over gangue referred to in patent 835,120. On that question the decision of this Court in the *Hyde Case* had no bearing. Patent 962,678 was not involved in the *Hyde Case*, nor mentioned therein. And the *scope* of the disclosure of patent 835,120 was not there in issue, as this Court subsequently pointed out in the *Butte Case*.*

In the *Butte Case*, which was not decided by this Court until *after* the decision of the Court of Appeals of the Third Circuit in the *Miami Case*, the "nature and extent of the disclosures" of patent 835,120 "with respect to the kinds and quantities of oil which may be used in the process" was for the first time in issue,** and this Court found (250 U. S., 349)

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*"While in the former case this Court was not called upon and in its opinion did not attempt, to define the scope of the claims, but was considering the patent only from the point of view of the invention and usefulness of the claimed discovery," etc. (*Butte Case*, 250 U. S., 341).

**"With the state of the prior art in mind, we come to consider the nature and extent of the disclosures of the patent in suit, but only with respect to the kinds and quantities of oil which may be used in the process" (250 U. S., 346).

> "that the only disclosure as to the kind and amount of oil which the patentees made to the public as necessary to the practicing of their process is that it must be an oil or oily substance, or oily liquid having a 'preferential affinity for metalliferous matter,' and that it shall be limited in amount 'to a fraction of one per cent. on the ore'."

If the Court of Appeals of the Third Circuit in the *Miami Case* had known what is conclusively proved in the instant case, that the soluble mineral-frothing agents named in the patent in suit are in fact oils, fatty acids, or other substances already known at the date of patent 835,120 to possess this preferential affinity for metalliferous matter, it could not have differentiated the disclosure of patent 962,678 from the disclosure of patent 835,120. The differentiation between "insoluble" oils and "soluble" oils, upon which plaintiff's whole argument rests in the instant case, is just as much a violation of the disclosure of patent 835,120 as was plaintiff's attempted differentiation between "frothing" oils and "non-frothing" oils in the *Butte Case*, where this Court said (250 U. S., 348):

> "From this consideration of the terms of the patent as written, it is apparent that it **makes no differentiation whatever**, either in the claims or in the specification, among the oils having a preferential affinity for metalliferous matter, and that its disclosure, to which the petitioners must be limited, is, that when a fraction of one per cent. on the ore of **any such oil** is used in the manner prescribed, there will be produced a metal-bearing froth, the result of the process"

and (p. 350):

> "Thus when to our former conclusion that the respondent used an efficient oil of the patent, we

> add the further conclusion, derived from a study of its terms, that the patentees **failed to differentiate** among the oils described in the patent, we must conclude that **it is impossible for the courts to distinguish among them,** as more or less efficient in the process, without amending the claims of the patent, and this they are powerless to do."

2. The assertion of plaintiff's counsel (brief, p. 2) that the Court of Appeals for the First Circuit in the instant case "refused to accept and follow the said decisions of this Court as to the nature of the invention of the earlier patent No. 835,120 and disregarded and overrode those decisions" is not true. On the contrary, the Court of Appeals of the First Circuit accepted and followed the decision of this Court in the *Butte Case* and regarded that decision (Opinion, R., I, 648) as a refutation of plaintiff's contention that the disclosure of patent 835,120 is limited to *insoluble* mineral-frothing oils, fatty acids, etc.; and as an affirmation of defendant's contention that the "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" of patent 835,120 include *soluble* oils, fatty acids and other kinds of substances specified in patent 967,678, and therefore anticipate that patent.

3. It is not true, as asserted by plaintiff's counsel (brief, p. 2) that the proofs as to the prior art are substantially the same in the two cases (the *Miami Case* and the instant case). It is true that patent 835,120 was put forward in the *Miami Case* as an anticipation of patent 962,678. But the opinions of the District Court and the Court of Appeals of the Third Circuit show that it was not there proved (or if proved was not brought to the attention of the court) that the "oils, fatty acids,

or other substances which have a preferential affinity" of patent 835,120 include the soluble oils, fatty acids and other substances of patent 962,678.

Argument.

Summary As to Anticipation of Patent 962,678 by the Disclosure of Patent 835,120.

Whether the disclosure of patent 835,120 does or does not anticipate the subject-matter claimed in patent 962,678 is a simple matter of fact. No question of law is involved, nor is the sometimes difficult question of invention, as distinguished from mechanical skill, presented. If the facts are as the Court of Appeals for the First Circuit found them to be, direct anticipation is established.

Summarily stated, the facts and the necessary conclusions from them are as follows:

Point 1.

The subject-matter claimed in patent 962,678 is the use of a "soluble" mineral-frothing agent in the agitation froth process of plaintiff's earlier patent 835,120. There is no other difference between them. The "soluble" mineral frothing agents named in patent 962,678 are "amyl acetate and other esters; phenol and its homologues; benzoic, valerianic and lactic acids; acetones and other ketones such as camphor" (R., II, 664, pat., p. 1, lines 33-36).

Point 2.

It is shown by the evidence and found as a matter of fact by the Court of Appeals of the First Circuit in

the instant case that these "soluble" mineral-frothing agents named and claimed in patent 962,678 are among the "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" referred to in patent 835,120.

Point 3.

Since the "soluble" mineral-frothing agents of patent 962,678 are substances already known to be included within the "oils, fatty acids, or other substances," etc., of patent 835,120, the disclosure of patent 962,678 (which is no more than an instruction to use these substances as flotation agents in the process of patent 835,120) contains no novelty and is not the basis of a valid patent.

Point 4.

Plaintiff's counsel seek to escape this conclusion by arbitrarily differentiating among the "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" referred to in patent 835,120. They say that the disclosure of patent 835,120 is limited to *insoluble* "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue". Neither the word "insoluble" nor any similar word is found in patent 835,120. Plaintiff's counsel seek to bridge this gap by pointing out that patent 835,120 speaks of coating the mineral particles and coupling this with the *assertion* that only insoluble substances can coat the mineral particles.

As to this question, whether or not soluble flotation agents coat the mineral particles, thus introduced into the discussion by plaintiff's counsel and therefore neces-

sary to be proved by plaintiff to support its contention that the disclosure of patent 835,120 is limited to insoluble substances, defendant's counsel reply:

(a) That if that fact were true, it would not make the disclosure of patent 835,120 any less an anticipation of patent 962,678. That patent 835,120 made to the man skilled in the art the general disclosure that "oils, fatty acids, or other substances" possessing this preferential affinity would produce the mineral-bearing froth if used in quantity less than one per cent. on the weight of the ore and subjected to agitation. It was wholly unnecessary for the man skilled in the art to know, and it made no practical difference in the availability of the process for different ores, whether the oils, fatty acids and other substances which display this preferential affinity for metalliferous matter over gangue are soluble or insoluble in the water of the pulp in the minute proportions specified in patent 835,120.

(b) That the evidence proves the fact to be that the oils, fatty acids, etc., referred to in patent 835,120, include the soluble oils, fatty acids, etc., named in patent 962,678; and that all these mineral-frothing agents whether soluble or insoluble, coat the mineral particles.

(c) That this attempt by plaintiff to prolong its monopoly by a limiting differentiation, excluding soluble substances from the "oils, fatty acids, or other substances" referred to in patent 835,120, is closely analogous to plaintiff's attempt in the *Butte Case* to enlarge its monopoly by a limiting differentiation excluding non-frothing oils from the "oils, fatty acids, or other substances" of patent 835,120. That attempt was disapproved by this Court in the *Butte Case* and by a parity of reasoning, the like attempt now made should be disapproved in this case.

POINT 1.

The subject matter claimed in patent 962,678 is the use of a "soluble" mineral-frothing agent in the agitation froth process of plaintiff's earlier patent 835,120. There is no other difference between them.

Plaintiff's counsel say in their brief (p. 39):

> "Generally comparing the process of the patent in suit with that of the first patent, No. 835,120, it is a fact that the only essential change in the things that are put into the pulp in the process of the patent in suit is that the agent is one which will go into solution in the water of the pulp instead of remaining undissolved therein."

and all the differences that they argumentatively assert between the two processes are attributed by them to the "change in the things that are put into the pulp."

This sole difference between the disclosure of patent 835,120 and the disclosure of patent 962,678 is expressed in the definitive words "in solution" of claims 1 and 2 of the patent in suit. These are words of exclusion intended to differentiate the claimed process from the process of patent 835,120.

These words give rise immediately to the inquiry whether, among substances already known to be available for use in the agitation froth process of patent 835,120, there were substances soluble in the proportions used in the process of that patent—i. e., "a fraction of one per cent. on the ore." If such soluble substances are embraced within the disclosure of patent 835,120, there is nothing added to the knolwedge of the art by the disclosure of patent 962,678, and the claimed monopoly of mineral-frothing agents "in solution" is unjustified.

In order to make this inquiry concrete, we note that the "soluble" mineral-frothing agents named in patent 962,678 are "amyl acetate and other esters; phenol and its homologues; benzoic, valerianic and lactic acids; acetones and other ketones such as camphor" (R., II, 664, patent, p. 1, lines 33-36). If we find those soluble mineral-frothing agents, or any of them, among the "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" of patent 835,120, then the answer to our inquiry must be an affirmative one and patent 962,678 must be invalid.

POINT 2.

It is shown by the evidence and found as a matter of fact by the Court of Appeals of the First Circuit in the instant case that the "soluble" mineral-frothing agents named and claimed in patent 962,678 are among the "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" referred to in patent 835,120.

For instance, phenol, one of the "soluble" mineral-frothing agents named in patent 962,678, the Court of Appeals of the First Circuit finds to be "specifically named in the prior art patent of Cattermole 777,274 and * * * among the oils or oily liquids of patent No. 835,120" (Opinion, R., I, 649). The Court said:

> "Phenol being among the oils or oily liquids of patent No. 835,120 and that patent having disclosed that by reducing the quantity used to a fraction of one per cent. on the weight of the ore and by vigorously agitating the pulp, the agent would effect the process of that patent, it is apparent that a clear disclosure anticipating the patent in suit is shown, for

> phenol in the quantity used in the process of that patent is wholly dissolved in water."

In like manner it was shown by the evidence in the instant case that amyl acetate and amyl alcohol are well known oils of commerce having preferential affinity for metalliferous matter and "undoubtedly oils of the prior art" (Opinion, R., I, 649); that valerianic acid "is a fatty acid of the prior art patents Nos. 835,120 and 777,274" (same page); and that "benzoic acid * * * is among the resin acids of Cattermole 777,274" (same page).

The question here presented is decisive of the case. Patent 962,678 is without novelty and cannot be sustained if this Court agrees with the Court of Appeals of the First Circuit that the "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue," known and available to the art at the date of patent 835,120 included the substances specifically named as examples of the soluble mineral-frothing agents in the specification of patent 962,678.

The Kinds of "Oils" Disclosed in Patent 835,120.

The place to begin the inquiry as to what is disclosed in patent 835,120 is in the specification of that patent (R., II, 1002-1007). That patent says (R., II, 1004, pat., p. 1, lines 9-15):

> "This invention relates to improvements in the concentration of ores, the object being to separate metalliferous matter, graphite, and the like from gangue by means of oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue."

What are these "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue"? The patent does not identify them any further, except that it names oleic acid as one example (pat., p. 1, line 80). Yet the patentees say (p. 1, lines 61, et seq.):

> "The proportion of mineral which floats in the form of froth varies considerably with different ores and with *different oily substances*, and before utilizing the facts above mentioned in the concentration of any particular ore a simple preliminary test is necessary to determine *which oily substance* yields the proportion of froth or scum desired."

Clearly the words "oils, fatty acids, or other substances," etc., refer to substances already known in this art to possess this "preferential affinity." They import into the disclosure of the patent all oils, fatty acids and other substances then known to possess that preferential affinity. There was no other source from which the man skilled in the art could select the "different oily substances" for the stated test with "different ores."

When we turn to this prior knowledge of the art thus imported into the disclosure of patent 835,120, we find that this preferential affinity for metalliferous matter over gangue was known to be possessed by a tremendous number of substances. So much so that such preferential affinity may almost be said to be a property, in greater or less degree, of all oils and oily substances, of all fatty acids, and of a great many other substances besides.*

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*The knowledge of the art in this respect is discussed by defendant's expert, Professor Taggart (R., I, 180-200). In that testimony he lists the oils, fatty acids, and other substances which in prior patents and publications had been shown to have this preferential affinity for metalliferous matter over gangue. For the convenience of the Court, we have extracted from that testimony, with reference to the patents and publications themselves, a list of these substances and have printed it in an appendix to this brief.

But to find complete anticipation of patent 962,678 it is not necessary to go beyond the prior patents and publications referred to by this Court in the *Hyde Case,* nor indeed to go beyond the prior patents specifically referred to in the specification of patent 835,120.

Discussing patent 835,120 in the *Hyde Case,* this Court said (242 U. S., 264):

> "It is clear that in the prior art, as it is developed in this record, it was well known that oil and oily substances had a selective affinity or attraction for, and would unite mechanically with, the minute particles of metal and metallic compounds found in crushed or powdered ores, but would not so unite with the quartz, or rocky non-metallic material, called 'gangue.' Haynes British patent (1860), and United States patents, Everson (1886), Robson (1897) and Elmore (1901). It was also well known this selective property of oils and oily substances was increased when applied to some ores by the addition of a small amount of acid to the ore and water used in process of concentration. United States patents, Everson (1886), Elmore (1901), and Cattermole (1904)."

In the Haynes British patent (R., II, 925), the "agent" disclosed "for obtaining minerals from ores" is (p. 925, lines 8-11):

> "bituminous matter (coal tar from gasworks, and such like, for instance), gums or gummy matter (amongst others, gutta percha, india-rubber, for instance), and fatty or oleaginous matter."

In the Everson patent, which first introduced the idea of increasing the preferential affinity by adding a small

amount of acid to the ore and water (R., II, 935), the agents are (p. 935, line 12) "fats or oils" and (lines 17-21)

> "a fat or an oil, either animal, mineral, or vegetable, or a fatty constituent or acid of an animal or vegetable fat or oil, or any constituent of a mineral oil"

and more specifically (lines 82-87):

> "I have used petroleum and one of its several constituents—namely, paraffine oils—also tallow (melted), lard, lard-oil, red-oil (impure oleic acid), cotton-seed oil, castor-oil, sperm-oil, and linseed oil, and some combination of these with each other."

In Robson's patent (R., II, 949) the preferentially selective agent used is (line 35) "an oily liquid," and more specifically (lines 43-46):

> "mixing a liquid hydrocarbon, such, for example, as turpentine, petroleum, paraffin, or the like, with a fatty oil such as colza-oil."

Elmore's patent (R., II, 953) says (lines 10-20):

> "This invention relates to apparatus for effecting the separation of minerals by the selective action of **oils and like substances** * * *.
>
> "In what follows **I shall use the word 'oil' to mean either oil or any other substance that can exert a selective action on minerals such as oil exerts.**"

Cattermole's patent 763,259 (R., II, 966) says (lines 9-16):

> "The present invention relates to the classification of the metalliferous constituents of ores which have

> been separated from gangue by **oil or similar matter, such as certain wood or coal tar products, hereinafter referred to as 'oil,'** in which term I also include the emulsifying agent when an emulsifying agent is present with the oil."

Cattermole's patent 763,260 (R., II, 970) says (p. 1, lines 12-18):

> "The present invention relates to improvements in the separation of the metalliferous constituents of ores and the like from gangue by means of the selective action of **oils and certain tar products or similar compounds (all hereinafter referred to as 'oil')** on metallic or metalliferous matter."

And (p. 971, lines 89-94):

> "The oil used may be **animal, vegetable, or mineral oil, or mixtures of these, or such coal or wood tar products or other substances which exercise, like oils, a preferential physical affinity for metallic mineral matter as distinguished from gangue.**"

The same language is repeated in Cattermole patent 777,273 (R., II, 974, 975).

In the British patent to Cattermole, Sulman & Picard* (R., II, 978) and in the corresponding United States patent 777,274 (R., II, 982) the patentees say (R., II, 982, lines 10-19):

> "Our process has for its object the separation of minerals from the silicious, or earthy matters of ores by means of soaps or similar compounds, and is dependent upon **the superior physical attraction**

*It will be noted that Sulman & Picard are the patentees of patent 835,120, and that Sulman is one of the patentees of patent 962,678 in suit.

exhibited by minerals for fatty or resin acids, or for certain other aromatic derivatives (such as cresols, phenols, etc.) which form soluble salts or compounds with alkaline hydrates as compared with earthy or silicious substances."

It is clear from these disclosures (and particularly from the practically identical phraseology used in the Sulman, Picard and Ballot patent 835,120, in the Cattermole patent and in the Cattermole, Sulman & Picard patent), that when the patentees of patent 835,120 used the words "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" they referred to and embraced all these substances that had already been shown to have this preferential affinity.

It is easy to imagine what plaintiff's counsel would have said, during the litigation on patent 835,120, *if any one using any of these substances in the agitation-froth process of patent* 835,120 *had attempted to assert that any one of these known oils, fatty acids, etc., was not embraced in the disclosure of patent* 835,120.

This Court, in the *Hyde Case*, after thus finding that it was well known that oils and oily substances had this selective affinity for metalliferous matter, went on to discuss (242 U. S., 264) the prior art *processes* for making use of that property in the separation of minerals from their ores; referring particularly to the surface flotation process in which the oil was used in sufficient quantity to float the mineral particles to the surface, and to the Cattermole metal sinking process in which the oil was used in very much lesser amount to agglomerate the oil-coated mineral particles into granules heavier than water, so that the granules would sink to the bottom of the containing vessel, permitting the gangue to be carried away by an

upward flowing stream of water. And this Court pointed out that the process of patent 835,120 differed from those prior processes in using a critically small amount of oil—amounting to a fraction of one per cent. on the ore—in conjunction with agitation that impregnated the mass of ore and water with air bubbles which rose to the surface as a mineral-bearing froth.

And in the *Butte Case*, this Court said (250 U. S., 346):

> "Here is the essence of the discovery and it is announced in these terms:
>
> 'We have found that if the proportion of oily substance be considerably reduced—say to a fraction of one per cent. on the ore—granulation ceases to take place, and after vigorous agitation there is a tendency for a part of the oil-coated metalliferous matter to rise to the surface of the pulp in the form of a froth or scum."

It was thus made clear that the discovery of patent 835,120 was a *process* discovery, depending upon the *amount* of the oily substance used and the *character of agitation* employed, and not depending upon the choice of the particular oil, fatty acid or other substance having the preferential affinity for metalliferous matter. As to all those substances, the new process was said to be, and was in fact, generally applicable. It was from these substances *generally* that the user of the new process was directed to choose the "different oily substances" for "different ores," in making the practical test set forth in the patent (R., II, 1004, lines 61-69).

Indeed the specification of patent 835,120 refers directly to the Cattermole patent 777,273 and to the Cattermole, Sulman & Picard patent 777,274, and differentiates the new process from the old Cattermole agglomerating process, not in respect of the kind of oils, fatty

acids or other substances employed as mineral-frothing agents, but wholly in respect of the quantity of oil, fatty acid or other substance employed and the kind and degree of agitation. The patentees said (pat. 835,120, R., II, 1004, lines 28 et seq.):

> "We have found that if the proportion of oily substance be considerably reduced—say to a fraction of one per cent. on the ore—granulation ceases to take place, and after vigorous agitation there is a tendency for a part of the oil-coated metalliferous matter to rise to the surface of the pulp in the form of a froth or scum"

If, therefore, the reader of patent 835,120 found that oleic acid (the only substance specifically mentioned in the patent) was not suitable for the particular ore from which he was trying to separate the metalliferous matter, his next step would be to look at the Cattermole patent and the Cattermole, Sulman & Picard patent to find "different oily substances" for his tests.

The Cattermole Patent 777,273 (R., II, 974) says the invention relates

> "* * * to improvements in the separation of the metalliferous constituents of ores and the like from gangue by means of the **selective action of oils and certain tar products or similar compounds (all hereinafter referred to as 'oil')** on metallic or metalliferous matter" (p. 1, lines 9-15).
>
> **"The 'oil' used may be animal, vegetable, or mineral oil or mixtures of these or such coal or wood tar products or other substances which exercise, like oils, a preferential physical affinity for metallic mineral matter as distinguished from gangue"** (p. 2, lines 89-94).

From this disclosure of the Cattermole granulation process the seeker for information as to what substances might be used in the process of patent 835,120 is directed somewhat more specifically than in patent 835,120 to animal, vegetable and mineral oils, in general, and particularly to coal tar and wood tar compounds, which are the substances that have had the widest use in industrial flotation of minerals.

Turning from the Cattermole patent to the Cattermole, Sulman & Picard patent 777,274 for further specific identification of the oils, fatty acids and other substances having a preferential affinity for metalliferous matter referred to in patent 835,120, the man skilled in the art would find that the Cattermole, Sulman & Picard patent 777,274 discloses unmistakably many of the very substances named in the patent here in suit. The patentees of that patent say (R., II, 982, lines 10-19):

> "Our process has for its object the separation of minerals from the silicious or earthy matters of ores by means of soaps or similar compounds, and is dependent upon the **superior physical attraction exhibited** by minerals for **fatty or resin acids or for certain other aromatic derivatives (such as cresols, phenols, etc.)** which form soluble salts or compounds with alkaline hydrates as compared with earthy or silicious substances."

The patented improvement of that patent was a method of thoroughly dispersing the fatty or resin acid or cresol or phenol throughout the pulp so that it could effectively exercise its selective function. To that end a soap compound of the fatty or resin acid or other aromatic derivative, such as cresol, phenol, etc., was substituted for the agent of the Cattermole patent 777,273. The soap compound, which was readily soluble in the

pulp, quickly disseminated the agent through the body of the pulp. Thereupon, by action of acid in the pulp on the soap compound, this compound was broken down, "liberating in a state of chemical subdivision the fatty or resin acid or other compound, such as cresol, etc., in intimate contact with the suspended ore particles" (R., II, 982; p. 1, lines 39 to 42).

Thus the man skilled in the art, looking to the disclosure of these Cattermole and Cattermole, Sulman & Picard patents to find substances other than oleic acid which have a preferential affinity for metalliferous matter over gangue, would find in this patent 777,274 not only the **fatty acids**, broadly mentioned in patent 835,120, but also **resin acids**, and more specifically, **cresol and phenol**, which are among the very substances named in the patent here in suit.*

Being thus told by the Cattermole patents that among the substances having preferential affinity for metalliferous matter over gangue are animal, vegetable and mineral oils, particularly coal tar and wood tar products; and fatty acids, resin acids, phenol and cresol, the mill man would, following the instructions of patent 835,120 (p. 1, line 61, et seq.), proceed to make the "simple preliminary test" on his ore with these agents. He would make that test with each of the selected substances. He would carry out the process described in that patent, using the ore he was trying to float and the several flotation agents in succession.

When among these agents he came to use in the process **phenol** or **cresol** in the specified quantities and with the apparatus and the degree of agitation disclosed in patent 835,120, he would produce a mineral-bearing froth and would find himself practicing the process of the patent in suit.

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*The patent in suit says (p. 1, line 34) "phenol and its homologues." Cresol is a homologue of phenol.

Plaintiff does not deny this. In fact that is the very disclosure of patent 962,678 when it says to use "phenol and its homologues" in the process described in patent 835,120.

That the man skilled in the art would thus determine the availability of the then known oils, fatty acids and other substances having preferential affinity for metalliferous matter over gangue to which patent 835,120 directs his attention and which were then known to possess that property, by the simple, practical test outlined in the patent; and that in so doing he would practice the process of the patent here in suit, is quite fully admitted by plaintiff's expert, Mr. Higgins, who said:

> (R., I, 495, XQ486.) "It has always been my opinion that the test of the suitability of an oil or mineral-frothing agent for use in the air froth flotation process, is the application of the process itself."
>
> (501, XQ519.) "There was nothing known at the date of that patent, was there, to prohibit or impede a man making such an investigation, to use the oils that Bessel had told him to use? A. No. * * *"
>
> (502, XQ525.) "A. My answer is as before, that a metallurgist would be justified in taking those which were oily in nature, such as resin oil."
>
> (XQ526.) "Well, if he did that, he would find some of them that were very substantially soluble in those proportions, would he not? A. Yes. * * *"
>
> (XQ527.) "* * * I asked you whether, if he took less than 1 per cent. upon the weight of the ore of one of these resin compounds indicated by this language from Bessel, and proceeded to put it in the Gabbett mixer with the pulp, and carried out the operation as you carried it out in Boston (the operation of patent No. 835,120), I say that he would

have gotten a mineral-bearing froth, would he not? A. With some of them, yes."

(XQ528.) "And he would have had present a mineral frothing agent in solution, would he not? A. He could have chosen one that would have given him that condition."

(XQ529.) "And if that process were carried out before you now with that particular substance, you would say that it was the practice of the process of the patent here in suit, would you not? A. No, I do not think so (and then after some discussion) I misunderstood your question, Mr. Davis. The answer there should have been 'Yes.'"

POINT 3.

We submit that this ends the matter. It leads necessarily to the conclusion, expressed in Point 3 (*ante*, p. 8) that **since some of the "soluble" mineral-frothing agents of patent 962,678 are substances already known to be included within the "oils, fatty acids, or other substances," etc., of patent 835,120, the disclosure of patent 962,678 (which is no more than an instruction to use these substances as flotation agents in the process of patent 835,120) contains no novelty and is not the basis of a valid patent.**

We must be right in saying that the instruction of patent 835,120 is to use in that process the already known oils, fatty acids and other substances having a preferential affinity for metalliferous matter over gangue; because there is no other instruction in the patent as to where the man skilled in the art is to find the "different oily substances" for "different ores." We cannot be wrong in saying that the proper test of other oily sub-

stances with other ores is the practical test of use, because that and no other is the test that patent 835,120 prescribes. Plaintiff's expert, Mr. Higgins, admits that it is "**the test** of suitability of an oil or mineral-frothing agent for use in the air froth flotation process"; and patents are addressed to practical men and not to theorists and rhetoricians.*

If we are right in these things, then we arrive, by immediate reference from patent 835,120 to the Cattermole patent and the Cattermole, Sulman & Picard patent, at a disclosure which completely anticipates the patent in suit.

That is the conclusion arrived at by the Court of Appeals of the First Circuit and expressed in that part of its opinion quoted *ante*, **pages 11-12.**

The Kinds of "Oils" Disclosed in the New Zealand Agitation Froth Patent (Corresponding to Patent 835,120).

Although we do not believe that any reasonable person can doubt that the instruction of patent 835,120 was to use in the new agitation froth process of that patent any and all known substances having a preferential affinity for metalliferous matter over gangue and particularly the oils, fatty acids and other substances of the Cattermole and Cattermole, Sulman & Picard patent; yet we proceed to direct the attention of this Court to the fact that in the Sulman, Greenway & Ballot New Zealand patent (R., II, 1011), which corresponds to the United States patent 835,120, **the disclosure specifically instructs the man skilled in the art to use phenol and cresol as flotation agents in a proportion less than one per cent. on the ore in the agitation froth process.**

The New Zealand patent, on pages 1, 2, 3 and 4, follows almost exactly the specification of the United States

*"The patent is not addressed to rhetoricians or verbalists, but to the workers in the art." *Bracewell* vs. *Passaic Print Works*, 107 Fed., 467-470.

patent 835,120 from the beginning of page 1 through line 45 of page 2. The difference between the two patents is that whereas the use of the oils and oily substances of the Cattermole patent 777,273 and of the Cattermole, Sulman & Picard patent 777,274 are imported into the United States patent by reference; the New Zealand patent **verbally and explicitly discloses the use of less than one per cent. (on the weight of the ore) of the fatty and resin acids and phenol and cresol in the agitation froth process.**

The New Zealand patent says (R., II, 1015):

> "Another feature of this invention consists in a method of producing and utilizing the fatty or resin acids or certain other aromatic derivatives (such as cresols, phenols, etc.) * * *."
>
> "In carrying out this part of our invention, the suitably crushed ore is suspended in water and to the mixture an addition of a small quantity of soap solution is made. A small amount of mineral acid is then added which decomposes the soluble soap or other similar compound by uniting with the alkaline base thereof, thus liberating in a state of chemical sub-division the fatty or resin acid or other compound such as cresol, etc., in intimate contact with the suspended ore particles. It is found that liberated fatty acids, which may even be solid in certain cases, are precipitated and under these conditions adhere to the sulpheretted minerals, or to sulphur, graphite, or free metals present in the ore, leaving the gangue or earthy particles preferentially wetted by water, and free from adhesions of fatty acid and the like."

The New Zealand patent then says (p. 1016):

> "If the proportion of fatty acid produced in the mixture be about 1% to 4% of the ore and if the

mixture be thoroughly agitated, the coated metalliferous particles will adhere together and form granules or small agglomerate masses which, partly by reason of gravity and partly on account of their bulk, as compared with the individual grains of gangue, may be readily separated in up-currents or by other suitable classification apparatus."

That is the Cattermole granulation process.

The New Zealand patent then goes on to say:

"If, however, the proportion of fatty acid be less than 1% of the ore a greater or less proportion of the coated metalliferous matter will form into a froth as described at the beginning of this specification."

That is the agitation froth process.

It is clear from the context that the words "fatty acid" in both the above statements refer back to the *group* of substances "fatty or resin acids or certain other aromatic derivatives (such as cresols, phenols, etc.)" with which the discussion of this feature of the invention opens and which group, in the disclosure of this feature (pp. 1015-1016), is variously referred to as "fatty or resin acid or other compound such as cresol, etc.," "fatty or resin acids," "fatty acids and the like" and "fatty acids."*

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*Note, for example, that in the paragraph immediately preceding, the patentees speak of "liberating in a state of chemical subdivision, the fatty or resin acid or other compound such as cresol, etc."; then at the beginning of the next sentence say that "liberated fatty acids" are preciptated; and at the end of the same sentence speak of the gangue particles as "free from adhesions of fatty acid, and the like."

The Court of Appeals of the First Circuit said, in the instant case (R., I, 649):

> **"This construction of patent No. 835,120 is confirmed by the disclosure in the New Zealand patent No. 19,633 of October 27, 1905, which corresponds to the United States patent No. 835,120, and was granted to the same persons for the same invention."**

And (p. 650):

> **"The words fatty acids as used in that paragraph refer back to the group of fatty acids and their derivatives cresol and phenol previously mentioned and plainly disclose that phenol is one of the frothing agents described in and made a part of patent No. 835,120; and if used in the fraction of one per cent. on the ore, the critical amount of the patent, the metalliferous matter will be coated and the froth formed."**

The Prior Art Disclosures of Other Soluble Mineral-Frothing Agents Than Phenol and Cresol.

But even if the words "fatty acid" here meant *only* fatty acids and nothing else, that would not make this statement in the New Zealand patent of 1905 any less a complete disclosure of the process of the patent here in suit; because among the fatty acids is *valerianic acid*, one of the "soluble" mineral-frothing agents named in the patent in suit (*post*, p. 30).

We have emphasized the explicit disclosure of the use of phenol and cresol in the agitation froth process of patent 835,120 and of the corresponding New Zealand

patent because phenol and cresol are explicitly named in patent 962,678 in suit.*

Plaintiff cannot monopolize what was already known; either the use specifically of phenol and cresol as mineral-frothing agents, or, generically, the use of a mineral-frothing agent wholly in solution.

Since defendant is not using any one of the mineral-frothing agents specifically mentioned in the patent in suit** we are not really concerned to inquire whether any residue of patentable novelty is left in the other agents specifically mentioned—amyl acetate and other esters, benzoic, valerianic and lactic acids, acetones and other ketones such as camphor.

It is only the broad monoply claimed—the monopoly of every organic mineral-frothing agent in solution—that defendant is charged with transgressing. That broad monopoly being untenable, the defendant must be discharged.

It is not, however, to be supposed that phenol and cresol are the only soluble flotation agents mentioned in the patent in suit that were included among the oils, fatty acids and other substances that patent 835,120 (and the corresponding New Zealand patent) directed the man skilled in the art to use. The "soluble" mineral-frothing agents, other than phenol and its homologue cresol, named in patent 962,678 are "amyl acetate and other esters; benzoic, valerianic and lactic acids; acetones and other ketones such as camphor" (pat., p. 1, lines 34-37).

Amyl Acetate and Other Esters.—The only substance for which the patent claims a specific monopoly—as distinguished from the broader monoply of all mineral-frothing agents in solution, within which the specific

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*"phenol and its homologues" (pat., p. 1, line 34). Cresol is one of the homologues of phenol.

**The mineral-frothing agent used by defendant is alpha naphthylamine, commonly known as X-cake (*post*, p. 79).

monopoly is included—is "an organic amyl compound" (claim 9).

The disclosure of the specification upon which this claim is based is the statement that the patentees "have found suitable for use as mineral-frothing agents with certain ores * * * amyl acetate and other esters."

Amyl acetate is described by Professor Taggart on pages 228 and 229 of the Record, Vol. I. It is a colorless, oily liquid commonly known as banana oil; a well known oil of commerce. When used in the proportions specified in Patent 835,120 it forms a mineral-bearing froth, thereby displaying its preferential affinity for metalliferous matter over gangue. It is clearly one of the oils or oily substances included within the broader expression of Patent 835,120.

Amyl alcohol is "an organic amyl compound" closely related, chemically, to amyl acetate. It is commonly known as "fusel oil" and is specifically mentioned as a flotation agent in the two Bessel German patents No. 42 of 1877 and No. 39,369 of 1887 (R., Vol. II, 928-934; Taggart, R., I, 186, Q6, and 242, Qs115-117). It is another wholly soluble organic mineral-frothing agent specifically mentioned in the prior art as one of the oily substances having a preferential affinity for metalliferous matter over gangue, suitable for use in these flotation processes. In fact, the second Bessel patent (R., II, 934) selects fusel oils as of special importance to be included among the preferred substances in the patent claim, saying "especially hydrocarbons in solid and liquid state, fusel oils, etc."

Amyl alcohol was also patented in the United States patent to Sulman 955,012 which is pleaded as a prior patent invalidating the patent here in suit and which is the basis of the second defense (R., II, 1060 and *post*, p. 59).

The Court of Appeals in the instant case said (R., I, 649):

> **"Amyl acetate known in commerce as banana oil, and amyl alcohol commonly known as fusel oil, both of which are specifically mentioned as mineral-frothing agents in the patent in suit [No. 962,678], have a preferential affinity for metalliferous matter and are undoubtedly oils of the prior art."**

Benzoic Acid.—Benzoic acid is a crystalline solid soluble in the proportion of .34 parts per 100 parts of water at 25° C. (Taggart, p. 231, Qs89-90). It is a **resin** acid and as such it is included in the flotation agents indicated in patent 835,120 by reference to patent 777,274 and by the direct statement in the New Zealand agitation froth patent 19,633: "fatty or **resin acids** or certain other aromatic derivatives (such as cresols, phenols, etc.)" (R., Vol. II, 1015). It is also indicated in the Bessel German patent—"All resins of the vegetable and mineral kingdom, their solutions, and the oils obtainable from them by dry (destructive) distillation" (Vol. II, 929).

The Court of Appeals said (R., I, 649):

> **"Benzoic acid is also one of the soluble mineral-frothing agents specifically mentioned in the patent in suit. It has a preferential affinity for metalliferous matter over gangue and is therefore included within the terms referred to in patent 835,120 as 'other substances' and is also included among the resin acids of Cattermole 777,274."**

Valerianic Acid.—Valerianic acid is a **fatty acid** completely soluble in water in the proportions used in flotation. It is a colorless, oily liquid (Taggart, p. 232, Q92). Being a well known **fatty acid**, it is directly included in the disclosure of patent 835,120. It is also

included in the disclosure of the Bessel patent 42 of 1877—"All fatty oils and solid fats of the animal and vegetable kingdom, and the **fatty acids** obtainable therefrom."

The other substances specifically named as soluble mineral-frothing agents in the patent in suit (lactic acid; acetones and other ketones such as camphor) are not mentioned in the prior art disclosures of substances having this preferential affinity. None of them has ever had any practical application in flotation (Taggart, R., I, 232-3, Qs94-96).

In the face of this complete anticipation, it is a natural question to ask how the patent was ever sustained by the courts of the Third Circuit in the *Miami Case* and by the District Court of Maine in the instant case.

The Error of Fact that Misled the Courts of the Third Circuit.

The answer to that question, so far as the courts of the Third Circuit are concerned, is that they decided the issue on a different state of facts. Those courts supposed, as their opinions clearly state, that the soluble agents of patent 962,678 (referred to by them as the second patent) are not oils, fatty acids or oily substances. Whether that error of fact was due to lack of proof, or to the tremendous absorption of the Judges in the difficult question of infringement of patent 835,120 (as to which Judge Buffington dissented from the majority of the Court), we do not know. But that those courts made that error of fact is clear from their opinions.

In the District Court, Judge Bradford said (*Minerals Separation* vs. *Miami Copper Co.*, 237 Fed., 609, at pp. 635-6):

"In the process of the second patent in suit,* **no oil, fatty acid, or oily substance is introduced** into the mixture."

* * * * * * * *

"The novelty of this invention is to be found * * * in the fact that a mineral-frothing agent as the means of separating the metallic particles from the gangue **is substituted for** the oil, fatty acid or other oily substance essential to the process of the first patent in suit."

In the instant case it is, on the contrary, proved that the soluble mineral-frothing agents named in patent 962,678 include in fact "oil, fatty acid or other oily substance"; and that they are not substituted for, but are chosen from among, the "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" of patent 835,120.

The Court of Appeals of the Third Circuit in the *Miami Case* said, in the majority opinion (244 Fed., 773):

"The difference between the two patents may be shortly stated to be this: The first process rests upon the use in very small quantity of **an oily substance that does not dissolve in water**, coupled with agitation of the pulp, and this succeeds in producing a special froth that is remarkably effective in recovering the minute particles of ore. The second process **does not employ oil**, or an undissolvable substance; on the contrary, the 'mineral-frothing agent' must be in solution, and *ex vi termini* must therefore be dissolvable. The specification disclaims the use of

*Three patents were involved in the *Miami Case*—(1) the agitation froth patent 835,120; (2) the patent here sued on, 962,678; and (3) the Greenway patent 1,099,699.

so large a quantity that part of it remains undissolved."

But in the instant case it is proved, and the Court found, that among the oily substances of the first patent 835,120 are many that **do** dissolve in the pulp water; that the substances named in the second patent 962,678 **include** oils and oily substances already known to be available for use in the process of the first patent, and that the supposed difference between the two patents does not, as a matter of fact, exist.

The District Court's Decision in the Instant Case.

So far as Judge Peters' decision in the instant case is concerned, it seems to us that the only encouraging thing that can be said about the specious and hair-splitting arguments advanced by plaintiff's counsel—resting on assertion, not on proof—is that they should ever have been able to persuade Judge Peters to accept them. And, reading Judge Peters' opinion, written more than four years after the case was submitted to him, we may be permitted to doubt that he would ever have reached that conclusion if he had allowed his mind to absorb the facts proved in the instant case, instead of resting on the erroneous decision of the Court of Appeals of the Third Circuit in the *Miami Case.*

The simple fact of the matter is that the disclosure of these agitation froth patents (835,120 and the corresponding New Zealand patent) is **not** restricted to **insoluble** oils, fatty acids and other substances having preferential affinity for metalliferous matter, but embraces **all** oils, fatty acids and other substances having that property. That fact is made so unmistakably plain by the language of the patent that discussion can only obscure it. When plaintiff tries to deny it in this Court, it is

again asking the Court to do what the Court refused to do in the *Butte Case*. Under these circumstances it is really unimportant to know, and only adds confusion to the discussion to inquire, how plaintiff's counsel propose to support their assertion that these disclosures of the agitation froth process **are** limited to **insoluble** substances. But, inasmuch as plaintiff's brief is wholly built upon that assertion, we feel obliged to discuss what counsel say about it.

POINT 4.

Plaintiff's counsel seek to escape this conclusion by arbitrarily differentiating among the "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" referred to in patent 835,120. They say that the disclosure of patent 835,120 is limited to INSOLUBLE oils, fatty acids or other substances which have a preferential affinity for metalliferous matter over gangue. Neither the word "insoluble" nor any similar word is found in patent 835,120. Plaintiff's counsel seek to bridge this gap by pointing out that patent 835,120 speaks of coating the mineral particles and coupling this with the assertion that only insoluble substances can coat the mineral particles. But that assertion is irrelevant, and besides, is not true.

Plaintiff's Primary Erroneous Assertion.

The first step in plaintiff's argument is the **assertion** that the disclosure of the agitation froth patent 835,120, and of the corresponding New Zealand patent, is restricted to **insoluble** oils, fatty acids or other substances having a preferential affinity for metalliferous matter

over gangue. Upon that assertion plaintiff's whole case depends.*

The word "insoluble" does not occur either in the specification or in the claims of patent 835,120. Nor is there any equivalent word therein, nor any reason for the practical man skilled in the art who reads it to suppose that when he goes about looking for "different oily substances" than oleic acid to test on "different ores" he has first to find out whether that oily substance is or is not soluble in the water of the pulp, when used in the proportions specified in patent 835,120.

The specification of the corresponding New Zealand agitation-froth patent 19,633 of June 27, 1905 (R., II, 1011-1033) not only fails to restrict the oils, fatty acids, and other substances to **insoluble** oils, fatty acids and other substances, but it verbally and explicitly includes (as patent 835,120 includes by reference) resin acids and aromatic derivatives, such as cresol, phenol, etc., among the oils, fatty acids and other substances that display this preferential affinity.**

The metallurgist, instructed by these simple and explicit statements, had only to test these "different oily substances" on the "different ores." Phenol and its homologue cresol are brought to the metallurgist's attention by name. He certainly would not fail to try them by the test of the agitation froth patent (R., II, 1004, and

*The assertion is made over and over and over again in plaintiff's brief, substantially in the words (p. 3) "A mineral frothing agent that dissolves in the water of the pulp *does not and cannot* coat the mineral particles." We have noted the same assertion on pages 9, 11, 12, 18, 27, 28, 29, 40, 77, 78, 79, 80, 81, 83 and 109. But plaintiff has not proved that it does not, and counsel do not explain why it cannot. The evidence is that it can and does.

**"Our process * * * is dependent upon the superior physical attraction exhibited by minerals for fatty or resin acids or for certain other aromatic derivatives (such as cresols, phenols, etc.)"—Cattermole, et al., 777,274 (R., II, 982, lines 10-20).

post, pp. 37, 47). When he did try them by that test, he would find that when phenol or cresol is added to the pulp in an amount less than one per cent. on the weight of the ore and subjected to agitation, there will be produced, (as the disclosures of the agitation-froth process says there will be), a metal-bearing froth that rises to the surface. He would find that the disclosed agitation-froth process is in fact effective with these different oily substances (including phenol and cresol) and he would neither know nor care whether the oily substances were dissolved or undissolved; or whether or not they coated the mineral particles.

There would not come into the mind of such a man any theoretical considerations as to the scientific mode of operation of the substances in the flotation process to deter him from making practical application of them in his mineral concentration plant.

Plaintiff's Secondary Assertion.

The second step in plaintiff's argument involves the further **assertion,** unimportant if true but contradicted by the evidence, that because patent 835,120 says that the flotation agents coat the mineral particles, it follows that the agents referred to must have been insoluble.

We call particular attention to the fact that **the burden of proof on this subject is wholly on the plaintiff.** It is the bridge by which they seek to span the gap between the actual disclosure of patent 835,120 (and of the corresponding New Zealand patent) and their primary assertion that these disclosures are restricted to insoluble substances.

(a) Even if **plaintiff had succeeded in proving this second assertion, it would not make the disclosure of patent 835,120 any less an anticipation of patent 962,678.**

The Cattermole patent and the Cattermole, Sulman & Picard patent had disclosed that these particular oils, fatty acids and other substances, including phenol and cresol, possess this preferential affinity for metalliferous matter over gangue. Patent 835,120 said that if you use any substance possessing that property in a quantity less than one per cent. on the weight of the ore with agitation, the metal-bearing froth will result. That is true —it will result with any of those substances. That is all the metallurgists needed to know in order to make practical application of these substances to the separation of mineral in the process of patent 835,120. When that result is produced by the use of the fatty acid, *valerianic acid*, or the resin acid, *benzoic acid*, or the aromatic derivatives *phenol* or *cresol*, the process of patent 962,678 is practiced. No theory can affect this practical result.

What difference could it make to the practical man skilled in the art whether the substances effect the preferential selection by coating the mineral particles or by modifying the character of the bubbles or in some other way not yet understood? How can the availability of these known substances in the process of patent 835,120 be affected by any scientific explanation, or lack of explanation, as to the physical principles and mode of operation involved in this process?

The specification of patent 835,120 (and of the corresponding New Zealand patent) supplies to the man skilled in the art an infallible test to determine whether a particular oil, fatty acid or other substance has the desired preferential affinity and will therefore effect the desired separation of the particular ore he is trying to treat. It is set forth in patent 835,120 at page 1, lines 61-69 (R., II, 1004). It was discussed and found to be sufficient for its purpose by this Court in the *Hyde Case* where this Court said (242 U. S., 270-271):

"Equally untenable is the claim that the patent is invalid for the reason that the evidence shows that when different ores are treated preliminary tests must be made to determine the amount of oil and the extent of agitation necessary in order to obtain the best results. Such variation of treatment must be within the scope of the claims, and the certainty which the law requires in patents is not greater than is reasonable, having regard to their subject-matter. The composition of ores varies infinitely, each one presenting its special problem, and it is obviously impossible to specify in a patent the precise treatment which would be most successful and economical in each case. The process is one for dealing with a large class of substances and the range of treatment within the terms of the claims, while leaving something to the skill of persons applying the invention, is clearly sufficiently definite to guide those skilled in the art to its successful application, as the evidence abundantly shows."

Among the things left "to the skill of persons applying the invention" is the selection of "different oily substances" for "different ores." The only oily substance named in the patent is oleic acid. From what oily substances, then, is the selection to be made? Clearly the answer is—from oils, fatty acids and other substances already known to possess this preferential affinity for metalliferous matter over gangue,—including the oils, fatty acids and other substances mentioned in the Cattermole patent and the Cattermole, Sulman & Picard patent referred to in the specification of patent 835,120.

This test was again discussed and approved by this Court in the *Butte Case* (250 U. S., 340-1) and it there formed the basis of the holding of this Court that patent 835,120 "makes no differentiation whatever, either in the claims or in the specification, among the oils having a

preferential affinity for metalliferous matter, and that its disclosure, to which the petitioner must be limited, is, that, when a fraction of one per cent. on the ore of any such oil is used in the manner prescribed, there will be produced a metal-bearing froth, the result of the process."

This test is indeed stated and approved by plaintiff's counsel in their brief at pages 34-35; and is there characterized by counsel as "the necessary and usual procedure of metallurgists."

Indeed the fact is that no practical man can determine or satisfy himself that an agent used in the small quantities prescribed in patent 835,120 does or does not *coat* the mineral particles. The ore pulp is a freely-flowing, muddy-looking liquor consisting of about four parts of water to one part of ore crushed almost to an impalpable powder. Using two pounds of oil per ton of ore (0.1% on the ore), this two pounds of oil will be dispersed throughout an ore pulp mass of 10,000 pounds (8,000 pounds of water plus 2,000 pounds of finely divided ore); such a relatively small proportion of oil as to be visibly undiscernible in the ore pulp.* As a matter of fact, the specification of patent 835,120 negatives the suggestion that the practical man could determine for himself whether an agent did *coat* the mineral particles, and specifically prescribes trial in the process itself as the proper means for determining the availability in the process of any particular agent.

(b) But quite aside from the fact that the practice of the process of patent 835,120 does not require the practical man to know, and in fact the practical man cannot

*A quantity characterized by this Court as "necessarily an infinitesimal amount" (*Hyde Case*, 242 U. S., 267) and by Lord Atkinson in the decision of the British House of Lords (*Hyde Case*, 242 U. S., 269) as "relatively infinitesimal quantities"; and by Judge Bourquin in the *Hyde Case* (207 Fed., 959) as "so little oil it disappears, is not sensible to sight or touch upon the concentrates, but only to analysis."

know, whether the flotation agent employed coats the mineral particles or not; we go on to point out that plaintiff could prevail only if the evidence proved that, in point of fact, soluble oils do not coat the mineral particles. **And the evidence proves the fact to be that soluble oils do coat the mineral particles by adsorption from solution.**

The District Court, in the instant case, remarked (R., I, 619) that

> "This is a region of disputation where experts and scientists occupy the field alone."

If that is true, it militates against the plaintiff, not against defendant, as the District Court concluded. The question involved is brought into the case by plaintiff to bridge the gap between the actual disclosure of patent 835,120 and plaintiff's interpretation of that disclosure. Plaintiff has the burden of proof. It cannot take even the first step in its argumentative departure from the real disclosure of patent 835,120 without first satisfying the Court that soluble substances do not coat the mineral particles.

The assertion is explicitly denied in defendant's proofs. Defendant's experts, Professor Taggart of the Columbia School of Mines and Dr. Bacon of the Mellon Institute, testified that the soluble mineral-frothing agents, notwithstanding the fact that they are in solution in the pulp, **coat** the mineral particles by **adsorption** from the solution onto the surface of the particles.* The phenomenon of adsorption from solution is a very well known one and underlies the silk-dyeing industry and other dyeing processes, as well as other industrial processes such as the decolorizing of oil and the removal of fusel oil from whisky (Taggart, R., I, 255, Q150).

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*See Taggart, R., I, 254-256, Qs149-150; 306, XQ369; 312-313, RDQs425-426; 583, Q449; and Bacon, 345, Q21.

Mr. Higgins' Demonstrations, and His Erroneous Deductions Therefrom.

To this testimony plaintiffs oppose the deductions drawn by its expert, Mr. Higgins, from two experiments performed by him at a demonstration in Boston during the trial.

Mr. Higgins took a quantity of zinc ore, divided it into two parts. The first part he subjected to the agitation-froth process using oleic acid as the mineral-frothing agent. The second part he subjected to the same agitation-froth process using phenol. He then took the mineral-bearing froth from the oleic acid treatment and put it on a filter letting the water run through the filter. And he did the same thing on another filter with the mineral-bearing froth of the phenol treatment. He then introduced the substance that remained on the filter from the oleic acid treatment into a fresh body of water in an agitation froth machine, agitated it and produced a second mineral-bearing froth. He then took the material remaining on the filter from the phenol treatment, introduced it into a fresh body of water in an agitation froth machine, agitated it, and found that it would not produce a froth.

From that he **deduced** that the mineral particles were not coated in the phenol treatment. That was an erroneous deduction. The experiment showed nothing about whether the mineral particles were coated or not. All it showed was that much of the oleic acid remained undissolved, while the phenol was dissolved, in the water of the pulp. When he put the mineral-bearing froth from the oleic acid treatment on the filter, the undissolved oleic acid was caught by the filter and remained with the filtered concentrates. Then when he put these concentrates of the oleic acid treatment into the fresh body of water for a fresh agitation, the undissolved oleic acid

that had been entrapped with the concentrates became at once effective to form a new froth. But the phenol, on the other hand, being in solution in the water of the pulp, drained through the filter with the water. When he put the drained phenol concentrates back into clean water and renewed agitation, he did not get a froth *because he had no frothing agent present.* The dissolved phenol had gone off with the water.

The mineral particles were coated with phenol, to be sure, but the coating produced by adsorption from the solution is of such a character that it will not wash off*—just as when, in the dye industry, a substance is dyed by adsorption from solution, the dye coating will not subsequently wash off—and even as oleic acid when it has once coated the mineral particles will not wash off and, if it is to be recovered at all, must be recovered in some such way as by the treatment of the oil-covered concentrate with alkali, as explained in the Cattermole, Sulman & Picard patent 777,274 (R., II, 983, lines 78, et seq., and plaintiff's brief, bottom p. 20).

Mr. Higgins should have seen this true explanation of the experiment (that in the oleic acid treatment substantially all the frothing agent remained with the mineral on the filter, while in the case of the phenol treatment all of the frothing agent went through the filter with the pulp water) from the fact, emphasized by plaintiff's counsel, that in the oleic acid treatment the water of the pulp that is left behind, if agitated anew with fresh ore, will not produce a froth (brief, p. 10); while in the phenol treatment, the water of the pulp that is left behind, if agitated anew with fresh ore, will produce a froth (brief, p. 10).

In addition to Professor Taggart's testimony already referred to, the fact that phenol, *which is a tar acid,* does coat the mineral particles is further proved by the ex-

*See Professor Taggart's testimony, R., I, 583, Q449.

tract from his article which plaintiff introduced on cross-examination (XQ414, R., I, 309), as follows:

> "After adsorbing a tar acid onto two 500-gm. lots of galena, in the one case below 200 mesh, in the other between 200 and 100, the solid was drained by suction filtration and then placed in a Janney laboratory flotation machine with about 1,500 cc. of water and agitated at 2,200 r. p. m. No froth at all was produced. Yet the amount of adsorbed oil present produced an appreciable froth when added anew even without a solid material to enhance the viscosity."

Other than these experiments of Mr. Higgins, which do not touch at all the question whether the soluble mineral-frothing agents coat the mineral particles, plaintiff produces no evidence to substantiate the assertion—necessary to plaintiff's argument—that only insoluble substances can coat the mineral particles. On the other hand, although the burden of proof was on plaintiff, not defendant, defendant has produced two men highly trained in the art (Professor Taggart and Dr. Bacon), both of whom testified affirmatively that the soluble substances do coat the mineral particles, and back up that testimony by the statement of qualitative and quantitative results.*

(c) The attempt by plaintiff to prolong its monopoly by a limiting differentiation, excluding soluble substances from the "oils, fatty acids, or other substances" referred to in patent 835,120, is closely analogous to plaintiff's attempt in the Butte Case to enlarge its monopoly by a limiting differentiation excluding non-frothing oils from the "oils, fatty acids, or other substances" of patent

*See footnote, *ante*, page 40.

835,120. That attempt was disapproved by this Court in the Butte Case and the like attempt should be disapproved in this case.

The *Butte Case* (250 U. S., 336) came to this Court after the Court had held in the *Hyde Case* (224 U. S., 271) that patent 835,120 was "confined to the results obtained by the use of oil within the proportions * * * amounting to a fraction of one per cent. on the ore." Defendant, in the *Butte Case,* was using a mixture of oils in quantity greater than one per cent. of the weight of the ore. Plaintiff contended that defendant nevertheless infringed, asserting that the mixture of oils was made up partly of frothing oils which were oils of the patent, and partly of non-frothing oils which were not oils of the patent. To this the defendant replied that all of the oils of the mixture were oils having a preferential affinity for metalliferous matter over gangue and were, therefore, among the oils, fatty acids or other substances of patent 835,120.

The decision of this Court rejected plaintiff's attempted differentiation among the oils of the patent, holding that patent 835,120 makes no differentiation whatever, either in the claims or in the specification, among the oils having preferential affinity for metalliferous matter, but includes any such oil; and that where the patent does not differentiate it is impossible for the Courts to differentiate (250 U. S., 348-350).

We submit that the same simple reason makes it impossible for the Courts now to differentiate between insoluble oils and soluble oils; and compels the conclusion that the disclosure of patent 835,120 made available to the man skilled in the art the agitation froth process using any oil, fatty acid or other substances (soluble or insoluble) having a preferential affinity for metalliferous matter over gangue.

The Fantastic Assertions to Which Plaintiff's Counsel Are Led in Their Attempt to Deny the Plain Disclosure of the Agitation-Froth Patent.

We shall not attempt to expose every erroneous deduction that plaintiff's counsel derive from their erroneous premises. But we shall point to some of the final conclusions which seem to us, in their fantastic character, to demonstrate doubly the falseness of plaintiff's position. It is usually the case that when, in an argument, one error is admitted to mar the simple truth, it demands other and still other errors to feed upon, and in turn propagates further errors to perpetuate itself.

Plaintiff's Contention That This Court in the Butte Case Passed Upon the Question Whether All Substances Having Preferential Affinity for Metalliferous Matter Necessarily Coat the Mineral Particles.

Plaintiff's counsel are profoundly embarrassed by the fact that their attempt here to differentiate between insoluble oils and soluble oils is precisely like their unsuccessful attempt in the *Butte Case* to differentiate between frothing oils and non-frothing oils.

To ease that embarrassment, they assert that this Court in the *Butte Case* held that the "oils, fatty acids, or other substances having preferential affinity for metalliferous matter" of patent 835,120 are restricted to substances that **coat the mineral particles.**

At the bottom of page 7 and top of page 8 of their brief counsel (in stating what this Court has decided as to the "kind of oil," that patent 835,120 discloses) quote the finding of this Court that the oil or oily substance or oily liquid must have preferential affinity for metalliferous matter, and then counsel insert their own addition (p. 7) "to the end that it may *preferentially coat that metalliferous matter*" (emphasis theirs). On page 9 they

refer to the conclusion of the Circuit Court of Appeals for the First Circuit as "the opposite conclusion."* On page 11 they say that

> "what this Court speaks of as the preferential affinity * * * is the power of the agent to preferentially coat those mineral particles * * *. Whatever has not that power of preferential coating is not the agent of patent No. 835,120. This is * * * the definition * * * given by this Court."

On page 78 they say that this Court recognized in its prior decisions that the use of the term "preferential affinity" in patent No. 835,120 "necessarily implied oil undissolved in water," and (p. 80) that this Court "clearly held that it did require the presence in the ore pulp of undissolved substances" and that there was expressed in the decisions of this Court in the *Hyde Case* and in the *Butte Case* "the limitation * * * as a necessary consequence of that preferential affinity, that it should coat the metalliferous mineral matter in the ore pulp."

And (p. 83) they say that the decision of this Court holding kerosene oil and fuel oil to be oils of the patent "obviously * * * assumed that the process disclosed in patent No. 835,120 required the presence in the pulp of an undissolved oily agent."

We do not think this Court in the *Hyde Case* or in the *Butte Case* put any restriction at all upon the oils, fatty acids and other substances having preferential affinity for metalliferous matter. The Court, as we read the opinion, was only concerned to know whether or not the particular

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*On page 12 this matter of coating is made the test of the patent. On pages 18, 27, 28, 29, 40, 77, 79 and 109 they repeat the assertion that only substances that coat metalliferous matter are included within the disclosure and couple it with the assertion that only undissolved substances can coat the metalliferous matter or display preferential affinity therefor.

oils there in question would display preferential affinity for the metalliferous matter by the practical test *of bringing the metalliferous matter to the surface of the pulp* in the agitation-froth process.

We do not think this Court was there concerned to know, and there was certainly no evidence by which it might determine, whether or not this preferential affinity would be displayed by substances that went wholly into solution in the pulp. It was urged by plaintiff, and agreed to by the Court, that pine oil, which is very largely dissolved in the pulp, is among the oils having preferential affinity for metalliferous matter. It was held, contrary to plaintiff's contention, that petroleum oils, which are very little dissolved in the pulp, are also oils having this preferential affinity. But the Court did not inquire whether or not the preferential affinity was dependent upon solubility.

In fact, the argumentative assertions of plaintiff's counsel lead them so far as to expose them to a comparison by parallel columns showing self-contradiction. Thus their statement on page 80 that this Court

> "clearly held that it did require the presence in the ore pulp of undissolved substances"

is directly contradicted by their statement on page 81:

> "No question of solubility entered into the subject matter this Court was considering. * * * That question ['whether or not these petroleum products were insoluble (immiscible) or soluble (miscible)'] was not under consideration."

Plaintiff's counsel assert that the test for oily substances in the agitation froth patent disclosure is whether or not they coat the mineral particles. The real test stated in

the patent is whether or not, when added to the pulp in a quantity less than one per cent. on the weight of the ore, they will produce a mineral-bearing froth.

Plaintiff's counsel (brief, pp. 11-12) say that—

> "The fallacy of the conclusion of the Circuit Court of Appeals in the instant case, as to anticipation by patent No. 835,120, is that it ignores the test by which the user of the process of patent No. 835,120, skilled in the art, would select any agent to be used in place of oleic acid."

And they go on to ask, with some emphasis (p. 11):

> "What is that test?"

And reply (p. 12):

> "It is written all over the patent and is woven all through the *Hyde* and the *Butte & Superior* decisions of this Court as stated.
>
> "That test is whether the agent in the small quantity prescribed will, as oleic acid does, preferentially coat the mineral particles * * *."

And in the footnote they say that "The test is stated or adverted to at the following places in patent No. 835,120" and list many references to the specification of the patent, at no one of which is the word "test," or any equivalent word, employed. On the other hand, they entirely omit from the list—and we would call the Court's particular attention to the significance of this omission—any reference to the plain and straightforward statement of patent 835,120 that "a simple preliminary test is necessary to determine which oily substance yields the proportion of froth or scum desired" (R., II, 1004, lines 66-69).

This is the only place that patent 835,120 says anything about a test.

The Contention of Plaintiff's Counsel that the Disclosure of the Kinds of Oils and Oily Substances Available For Use in the Agitation-Froth Process of Patent 835,120 *Are Restricted to Oleic Acid.*

This idea is introduced into plaintiff's brief first on page 3. It is followed by the assertion (pp. 16, 19, 21 and 86) that the reference in patent 835,120 to the Cattermole patent 777,273 and to the Cattermole, Sulman & Picard patent 777,274 did not import "into the disclosure of that patent No. 835,120 agents specified in those prior art patents" (p. 16). That is followed by the assertion (pp. 13, 23-24,* 43, 44, 45, 47, 50, 52 and 122) that only oleic acid was available for use in that process until after the discovery of patent 962,678; and that it was the discovery of patent 962,678 that advanced the art beyond the use of oleic acid to the solution of the problem of floating other ores and particularly the great body of porphyry copper ores in America (pp. 43, 45, 47, 50, 52 and 122).

It seems to us absurd to say that the reference to the Cattermole patent and to the Cattermole, Sulman & Picard patent did not import into the disclosure of patent 835,120 the oils, fatty acids and other substances having the preferential affinity for metalliferous matter mentioned in those patents. We think plaintiff's contention is completely answered by the question—Where, other than from the knowledge of the man skilled in the art (and particularly from the disclosures of these patents

*At *page* 23 "Oleic acid was the only oily substance that was actually used in practice" prior to the invention of the patent here in suit." And *page* 24: "The use of mineral-froth flotation was limited to these Australian zinc-lead ores and was not extended to other ores until after the invention in issue was made."

referred to in patent 835,120), was the metallurgist, reading patent 835,120, to find the "different oily substances" to use in his simple preliminary tests of "different ores"?

Furthermore, we have seen that the New Zealand agitation froth patent specifically directs the use of fatty and resin acids and other aromatic derivatives, such as phenol and cresol, in quantity less than one per cent. on the weight of the ore, in the agitation froth process.

Still further, this Court, in the *Hyde Case*, sustaining what was then plaintiff's contention and supporting thereby its holding that invention was involved in patent 835,120, said (242 U. S., 270):

> "The record shows not only that the process in suit was promptly considered by the patentees as an original and important discovery, but that it was immediately generally accepted * * * it promptly came into extensive use for the concentration of ores in most, if not all, of the principal mining countries of the world, notably in the **United States, Australia, Sweden, Chile and Cuba**, and that, because of its economy and simplicity, it has largely replaced all earlier processes."

Again this Court said, in the *Butte Case* (250 U. S., 343):

> "In each of the four claims of the 'Complete Specification' of the British patent, filed by the same persons who were patentees of the patent in suit, on June 3, 1905, 'petrol' is given as an equivalent of oleic acid in the process. * * * 'Petrol' is the name used in England for gasoline."

Still further there appears in this record (Defendant's Exhibit 120, R., II, 1185-1206) a report made by Messrs. Sulman & Picard to Minerals Separation, Ltd., in which

those engineers say, under date of May 3, 1905 (R., II, 1200):

> "We may here conveniently note that other oils besides Oleic acid may be employed in this modified recovery process, but so far as Broken Hill is concerned Oleic acid gives by far the best results."

The date of this report is twenty-six days before the filing of the United States application on which patent 835,120 was issued; **and almost exactly four years before the filing of the application for the patent in suit.**

Thus when plaintiff's counsel now assert that the failure to use, in the agitation-froth process, substances other than oleic acid in treating the Australian ores was due to a lack of knowledge subsequently disclosed in the patent here in suit, they are directly contradicted by the reports of plaintiff's own engineers made many years before this controversy arose and four years before the so-called discovery of patent 962,678.

Still further plaintiff's contention here that the porphyry ores had been floated by the process of the patent here in suit and not by the process of patent 835,120 is directly contrary to its assertion in the *Miami Case* and to the decision of the Courts of the Third Circuit in that case. In the District Court's decision in the *Miami Case*, Judge Bradford said (237 Fed., 618):

> "A great advance in the art of ore concentration has resulted from the process of **the first patent** in suit in the efficient recovery of slimes. With the use of **that process** ore may be so finely ground as to insure the thorough separation of the metallic particles and gangue, and great savings effected. The profit so saved in a single year from the output of the principle **porphyry copper mines**, including the defendant's, has been estimated by one of the expert witnesses as more than $17,000,000."

It is plain enough that these present extraordinary assertions by plaintiff's counsel, so contradictory of the plain facts and of what the same counsel urged upon this Court and the other courts in the litigation on patent 835,120, are made here in an attempt to bring to the support of the patent now in suit the same great commercial success that counsel formerly, and correctly, attributed to patent 835,120. In this way counsel seek to escape the troublesome fact, proved in this record, that the soluble mineral-frothing agents named in patent 962,678 have never had any commercial use (see Taggart, R., I, 232, Qs94 and 233, Q97).

There is no evidence that any one of them ever got beyond experimental use, excepting possibly cresol, and it was immediately found that cresol, as such—that is pure cresol which would go wholly into solution in the pulp—was not a good flotation agent; or at least not good enough for commercial use (Chapman, R., I, 556, Qs125-6).

In this same connection, plaintiff's counsel assert that the use of pine oil in the agitation froth process (p. 31) and the use of wood tar in that process (p. 47) did not become possible until after the disclosure of the patent in suit.*

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*On page 87, plaintiff's counsel say:

> "No one ever used these tar products in carrying on the Cattermole process. No one used these tar products in carrying on the process of patent No. 835,120, no one used these tar products for jointly carrying on the process of patent No. 835,120 and the process of the patent in suit, until long after the discovery and invention of the process in suit."

But there is not a scrap of evidence to support these assertions. They are such assertions as counsel sometimes permit themselves to make thoughtlessly in the heat of argument. The evidence does not go at all to what substances were actually used in the Cattermole process. These tar products are admittedly foremost among the flotation agents in the process of patent 835,120. Whether these tar products were among the "other oils" that Messrs. Sulman & Picard had found to be available prior to May 3,

(*Footnote continued on next page.*)

The absurdity of this is manifest. It was plaintiff's contention in the *Butte Case* that pine oil was the *only* one of the three oils there used that was an oil of patent 835,120. This Court held that not only pine oil but also kerosene and fuel oils were oils of patent 835,120.

Furthermore, as the Court of Appeals of the First Circuit pointed out (R., I, 643, 652) the patent in suit expressly disclaims (pat., p. 2, lines 68-77) the use of substances (like pine oil and the coal and wood tar products) that are not wholly soluble in the pulp water, saying:

> "We disclaim any such use of these substances and only claim them in such amount as will enable them to dissolve in the acidified water."

Of all oils and oily substances that anyone could pick out as characteristic oils of patent 835,120, the products of wood tar and coal tar are the most prominent and most frequently referred to in the prior art.

Professor Taggart's testimony (R., I, 180-200, and appendix to this brief) shows that these products of coal tar and wood tar are mentioned in nearly every one of the earlier patents in this art of separating minerals from gangue by use of the preferential affinity of oils and oily substances for metalliferous matter.*

1905, does not appear one way or the other. But if anyone could have proved that these tarry substances were not among them, it would have been plaintiff.

*See Haynes British patent of 1860, R., I, 181, "coal tar from gas works"; Bessel German patent of 1877, same page, "tar from brown coal, anthracite coal, wood and peat, and also the oily products of the distillation of these tars"; the Bessel German patent of 1886, page 186, "mineral tar"; the Cattermole U. S. patent 763,260 of 1904, page 189, "such coal or wood tar products or other substances which exercise, like oils, a preferential physical affinity for metallic mineral matter as distinguished from gangue"; Elmore U. S. patent 826,411 of 1906, page 199, in which process the art actually used, see page 200, "a large variety of oils and similar substances

(*Footnote continued on next page.*)

The fact that these coal tar and wood tar oils are within the disclosure of the prior art necessarily cancels all that plaintiff's counsel say as to the great utility of the alleged invention of the patent in suit. Coal-tar and wood-tar oils have been, since the very inception of the art in the Haynes British patent to the present day, typical flotation agents.

When plaintiff's counsel say that the use of such a coal tar or wood tar oil is at once the practice of the process of patent 835,120 and the practice of the process of the patent in suit, they merely assert that the process of the patent in suit was disclosed in patent 835,120. That is obviously true because, even if we should accept plaintiff's contention, above referred to, that coating the mineral particles is the test of the patent, these substances (pine oil and coal tar and wood tar products) certainly respond to that test. By that very test that plaintiff's counsel themselves supply, the man skilled in the art would include pine oil and these coal tar and wood tar products among the oils of patent 835,120. When he used them, he would get the characteristic froth of the agitation froth process and if, as plaintiff contends, their use is a practice of the process of 962,678, that process would be completely anticipated by such use.

In fact plaintiff's contention, if we should adopt it, would lead to the conclusion that not even oleic acid is an oil of patent 835,120 because the evidence is that oleic acid is itself partially soluble in the proportions used in agitation froth flotation, and that it is upon that partial solubility that the froth-forming power of oleic acid depends.*

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* * * such, for instance, as * * * tars, blast furnace oils," which is coal tar creosote; and Cattermole's U. S. patent 777,273, R., II, 975, line 91, "coal or wood tar products."

*See Professor Taggart's testimony (R., I, 213-214, Qs46-49); the article by Mr. Sulman published in 1919 and quoted from by Professor Taggart, R., I, 214; Professor Taggart (R., I, 217-218, Q54); and De-

(*Footnote continued on next page.*)

The Attempt of Plaintiff's Counsel to Avoid the Disclosure of the Cattermole Patents and the Cattermole, Sulman & Picard Patents on the Ground that Their Processes Are Different.

Plaintiff's counsel say (Brief, p. 85) of the disclosure in the Cattermole patents with respect to the use of certain oily substances, that:

> "Obviously the use of these products in this process where the recovery of concentrates was by sinking would not in any manner have informed the art of any possible use of these wood or coal tar products in processes where the recovery of concentrates was by flotation."

And by this same argument, based on the disclosure of the particular **processes** of these prior art patents, plaintiff's counsel seek to exclude from consideration all of the oily substances mentioned therein (pp. 87-93).

But that attempt evades the very point of the disclosure of patent 835,120 which was that (p. 1, lines 28, et seq.):

> "We have found that if the proportion of oily substance be considerably reduced—say to a fraction of one per cent. on the ore—granulation ceases to take place,"

referring, of course, to the oily substances and the granulation of the Cattermole process.

Counsel's Misquotation to Support the Assertion That the References in Patent 835,120 *to Patent* 777,274 *Are "Specifically Confined to the Disclosure of Oleic Acid Therein."*

The attention of this Court is specifically directed to the quotation from patent 835,120 on page 21 of plain-

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fendant's Exhibit 95 (R., II, 1099) and Taggart's testimony about it (R., I, 237-239); and the finding of the Court of Appeals of the First Circuit (R., I, 651).

tiff's brief, and to what counsel say about it. In the patent itself, the words immediately following the two sentences quoted on page 21 of plaintiff's brief are "The oleic acid *or other fatty acid,*" *etc.*

Yet plaintiff's counsel, omitting these words, here ask the Court to "particularly" note that "these references in patent No. 835,120 to the process disclosed in patent No. 777,274 are limited to oleic acid," and on page 91, they say again:

> "the two references to this patent were carefully confined to the disclosure of oleic acid therein."

In addition to this misquotation from patent 835,120, counsel seek to evade the reference in that patent to the Cattermole, Sulman & Picard patent 777,274, by saying (brief, p. 86) that the Cattermole patent 777,273 is "the principal patent for the Cattermole metal sinking process" and is the disclosure referred to in patent 835,120 to describe the advance which the agitation froth process made over the Cattermole agglomeration process. The truth is that the Cattermole agglomeration process is described in patent 777,274, as well as in patent 777,273, and the reference of patent 835,120 is to both of them. But if the reference were only to patent 777,273, that would not help plaintiff. In fact, it would absolutely contradict plaintiff's contention that the oily substances, referred to on page 1, line 29 of patent 835,120, are limited to oleic acid. Because, in the Cattermole patent, 777,273, the words "oleic acid" are not found. The oils disclosed there (R., II, 975, lines 90, et seq.) are:

> "Animal, vegetable, or mineral oil or mixtures of these or such coal or wood tar products or other substances which exercise, like oils, a preferential physical affinity for metallic mineral matter as distinguished from gangue."

Plaintiff's Assertion that the Disclosure of the New Zealand Patent is "A Mere Juxtaposition" of the Three United States Patents.

It is plaintiff's assertion that the New Zealand patent is a mere juxtaposition for the sake of economy of the disclosure of U. S. Patents 835,120 and "two prior Cattermole patents"* (brief, pp. 16 and 93-99). We do not know how that could lessen its disclosure if it were true. The New Zealand patent may be a juxtaposition of the explicit disclosure of three United States patents, but it is more than a "*mere*" juxtaposition of the explicit disclosure of the United States patents because it makes explicit, what the United States patent 835,120 disclosed by reference, that the fatty and resin acids and other aromatic derivatives such as phenol and cresol of the Cattermole, Sulman & Picard patent 777,274 are to be used in the agitation-froth process in a quantity less than one per cent. on the weight of the ore, and when so used will produce the characteristic mineral-bearing froth.

Finally, we submit that counsel's summary statement of plaintiff's position, at the end of their brief, discloses its fallacy.

Counsel say (p. 124):

> "Nobody skilled in the art derived at the time of its issue, or afterward, from patent No. 835,120 knowledge sufficient to enable him to understand the **nature and operation** of the invention of the patent in suit No. 962,678 and **to carry** the process of the patent in suit **into practical use.**"

We think it is true, as plaintiff's counsel repeatedly assert (pp. 42, 43, 44 and 45) that the "nature and operation" of the phenomena involved in the agitation-froth process cannot even now be explained. At any rate there

*Plaintiff's brief does not identify them. We assume counsel mean 777,273 and 777,274.

is not yet any explanation that has been generally accepted. That is true whether the agents used are soluble or insoluble. The fact *is* known that all of these substances which display preferential affinity for metalliferous matter over gangue coat the mineral particles, either by mechanically smearing them in the case of undissolved agents, or by adsorption from solution in the case of dissolved agents. The fact is also known that all substances which produce froth contain a soluble constituent.

The modern theory is that the froth formation is dependent upon the modification of the water by the soluble constituent, and that the selection of the mineral particles, in preference to the gangue, results from the fact that they are coated with a film of the flotation agent.

But it is the practical aspect, not the theoretical aspect, that is important to the mill man. He does not have to know what the theory is if he knows how to proceed in the mill. He was immediately able, upon reading patent 835,120, "to carry the process * * * into practical use" by the simple expedient of adding to the pulp less than one per cent. of any oil, fatty acid or other substance that had, in the prior art, displayed a preferential affinity for metalliferous matter over gangue, and then subjecting the pulp to agitation to produce the mineral-bearing froth.

We submit, therefore, that the Court of Appeals of the First Circuit was right in finding that the patent in suit is completely anticipated by patent 835,120; and that this decision should be affirmed.

The remainder of this brief is devoted to the other defenses. It need not be considered by this Court unless this Court is prepared to reverse the Court of Appeals of the First Circuit and is then disposed to consider the other defenses rather than to refer the case back to the Court of Appeals of the First Circuit for further consideration.

Second Defense.

The patent is invalid because of the prior invention and patenting by Sulman, United States patent 955,012, of the use of the soluble mineral-frothing agent, alcohol, in solution in the pulp in the froth flotation process of patent 835,120.*

This defense is pleaded in the answer under paragraph 9(a) (1) (R., I, 37), and in the amendment to the answer under paragraph 9-G (R., I, 95). It is the *fourth* defense of U. S. C., Tit. 35, Sec. 69 (R. S., Sec. 4920) which provides, among the defenses to a suit for infringement, that the patentee "was not the original and first inventor or discoverer of any material and substantial part of the thing patented."

The question here involved is wholly a question of the dates available to the two patentees; whether the Sulman patent 955,012 is entitled to an earlier date of invention than the patent here in suit. The subject matter claimed in claims 1 and 2 of the patent here in suit is unquestionably disclosed in the Sulman patent.

We say this despite the fact that plaintiff in the court below insisted that the disclosure of the Sulman patent was not a disclosure of the same invention patented in claims 1 and 2 of the patent in suit.

To our minds that contention is simply fantastic. The subject matter patented in the patent in suit is the "process of concentrating ores which consists in mixing the powdered ore with water containing in solution a small quantity of a mineral-frothing agent, agitating the mixture to form a froth and separating the froth" (Pat. claim 1). The truth and sincerity of plaintiff's counsel's contention that this invention is not disclosed in the Sul-

*Defendant's Exhibits Nos. 70, 71 and 72, Vol. II, pages 1054, 1058 and 1063.

man patent can, we believe, be tested at any time by asking them the direct question whether or not the process disclosed in the Sulman patent is a process of concentrating ores which consists in mixing the powdered ore with water containing in solution a small quantity of a mineral-frothing agent, agitating the mixture to form a froth and separating the froth.

Plaintiff cannot answer that question otherwise than affirmatively.

Sulman in his patent says (R., II, 1060):

> "According to this invention the crushed ore is introduced into water containing a very small percentage of certain alcohols such as amyl-alcohol and containing also a small percentage of a suitable acid such as sulphuric acid, and the mixture is thoroughly agitated. The ore particles are caused to come into contact with a gas such as air; and the result is that metallic sulphid particles float and they can thereafter be separated by any well-known means."

In the examples given (R., II, 1060, lines 34, 57 and 83) it is explained that the mineral frothing agents used are *in solution* in the pulp; and the specification of the Sulman patent contains this statement (lines 78, et seq.):

> "According to this invention the mineral-frothing agent or agents which enables metallic sulphids to float under the condition specified, consists of an alcohol such as amyl-alcohol contained in solution in the acidified water."

which is to be compared with the statement in the patent in suit (p. 2, lines 62, et seq.):

> "According to this invention the mineral-frothing agent consists of an organic compound contained in solution in the acidified water."

It is apparent, therefore, that the patent in suit is invalidated by the Sulman patent 955,012 if the effective date of that patent is earlier than the effective date of the patent in suit.

The respective dates of the Sulman Patent 955,012 and of the patent in suit, and of the corresponding United States and British applications are as follows:

	Patented in United States	Filed in United States	Filed in England
Sulman 955,012	April 12, 1910	Nov. 22, 1909	Dec. 24, 1908
Sulman, Greenway & Higgins, 962,678	June 28, 1910	Apr. 30, 1909	Feb. 1, 1909

This Court has held (*Alexander Milburn Co. vs. Davis-Bournonville Co.*, 270 U. S., 390) that a description in a patent issued prior to the patent sued on, and based on an application filed before the filing date of the patent sued on, is prior knowledge of the invention and invalidates the patent sued on under the fourth defense of R. S., Sec. 4920.

Applying the law of that case to the facts here, the patent here in suit will be invalid if the Sulman patent is entitled to an application filing date earlier than the filing date of the patent here in suit. The filing date to which the two patents are respectfully entitled is determined by the provisions of U. S. C., Tit. 35, Sec. 32 (R. S., Sec. 4887), since both the patent in suit and the anticipating Sulman patent were granted on applications filed by foreign inventors.

Section 4887 of the Revised Statutes provides that:

> "An application for patent for an invention or discovery or for a design filed in this country by any person who has previously regularly filed an application for a patent for the same invention, discovery, or design in a foreign country which, by treaty, convention, or law, affords similar privileges

to citizens of the United States shall have the same force and effect as the same application would have if filed in this country on the date on which the application for patent for the same invention, discovery, or design was first filed in such foreign country."

Under this statute, the effective date of the patent in suit is the British filing date, February 1, 1909,* and the effective date of the Sulman U. S. patent 955,012 is the British filing date, December 24, 1908. Sulman is, therefore, the prior inventor.

A situation on all fours with that here presented was considered by the Circuit Court of Appeals for the Fourth Circuit in *Federal Yeast Corporation* vs. *Fleischmann Co.*, 13 F. [2d], 570. In that case, the Court held that a patent of Hayduck No. 1,449,103, issued on March 20, 1923, upon an application filed in the United States Patent Office on October 30, 1920, was entitled to a filing date of March 15, 1915** (the date of filing of a German patent for the same invention), and that the Hayduck patent, therefore, anticipated a patent in suit of Nilsson and Harrison No. 1,449,103, issued March 20, 1923, upon an application filed in the United States Patent Office on January 7, 1919.

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*It is referred to in plaintiff's brief (p. 46) as "February 1, 1909, the record date of the invention in issue."

**The Court said (13 F. [2d], 571):

"In our Patent Office, their [Nilsson and Harrison] application preceded that of Hayduck by almost two years. Nevertheless he was entitled to priority over them because as early as March 15, 1915, he had asked for a German patent for the same invention, and his American application by virtue of section 4887 of the Revised Statutes (Comp. St., 9431), and of the Act of March 3, 1921, 41 Stat., 1313 (Comp. St. Ann. Supp., 1923, 9431a-9431h), commonly called the Nolan Act, is to be treated as if it had been then made."

There is, we submit, no answer to this proposition. Under the law as stated by this Court in the *Milburn Case* and Section 4887 of the Revised Statutes, the patent in suit is invalid in view of the Sulman patent No. 955,012.

We, therefore, submit that the patent in suit is invalid because of the prior invention and prior patenting by Sulman, in U. S. Patent 955,012, of the use in froth flotation of alcohol—a wholly soluble mineral-frothing agent.

Third Defense.

The patentees, Sulman, Greenway and Higgins, were not the joint inventors of the subject matter of the patent in suit. On the contrary, two of the patentees, Sulman and Higgins, knew, prior to any date available as a basis for the patent here in suit, that the froth flotation process of patent 835,120 could be practiced with phenol, with cresol, and with certain alcohols that were so soluble that they wholly dissolved in the pulp.

The third defense, that the patentees Sulman, Greenway and Higgins were not the joint inventors of the subject matter of the patent in suit is supported by proof that, quite aside from the just above discussed Sulman United States patent 955,012, and the British application of December 24, 1908, upon which the application for that United States patent was based, both Sulman individually and Higgins individually, prior to February 1, 1909, the earliest date available to the plaintiff as the date of alleged joint invention of the patent in suit, had full knowledge of the process patented in the patent in suit, i. e., the process of concentrating ores which consists in mixing the powdered ore with water containing in solution a small quantity of a mineral-

frothing agent, agitating the mixture to form a froth, and separating the froth.

That being so, neither Sulman nor Higgins could have believed that the alleged invention of the patent in suit was the joint invention of Sulman, Higgins and Greenway.

U. S. C., Tit. 35, Sec. 72 (R. S., Sec. 4923), provides:

> "Whenever it appears that a patentee, at the time of making his application for the patent, believed himself to be the original and first inventor or discoverer of the thing patented, the same shall not be held to be void on account of the invention or discovery, or any part thereof, having been known or used in a foreign country, before his invention or discovery thereof, if it had not been patented or described in a printed publication."

From this statute it follows, of course, that the patent will be held to be void if the patentees had knowledge of the prior work (whether done abroad or at home), and consequently did not believe themselves to be the original and first inventors of the thing patented.

The defense is pleaded as follows:

Answer, paragraph 9, section c (Vol. 1, p. 40):

> "That the patentees Sulman, Greenway and Higgins were not joint inventors of the subject-matter alleged to be patented by said Letters Patent No. 962,678 or any substantial or material part thereof."

Amendment to Answer, paragraph 9, section F (Vol. I, p. 95):

> "That the patentees Sulman, Greenway and Higgins falsely made oath that they believed themselves

to be the inventors of the subject-matter of the said letters patent, or of so much thereof as the defendant is charged with infringing, when in fact at the date of filing the application on which the said letters patent in suit were granted, they, or some, or all of them, knew that the said subject-matter was already known individually to the said Higgins and the said Sulman, each of whom had previously individually filed applications for letters patent therefor in Great Britain."

That Sulman, at least as early as December 24, 1908, knew how to practice a process of concentrating ores which consists in mixing the powdered ore with water containing in solution a small quantity of a mineral-frothing agent, agitating the mixture to form a froth and separating the froth, has been shown in our preceding discussion of the second defense. Having that knowledge, which he professed was of his own discovery or invention, as early as December 24, 1908, he could not have been a joint inventor of that subject matter with Higgins and Greenway on February 1st, 1909.

Similarly, the record here shows that Mr. Higgins knew, and took steps to patent in England, that phenol and cresol and other related substances would act as mineral-frothing agents in solution in such a process. That fact is proved by the Provisional Specification of the Higgins British patent of December 10, 1908 (R., II, 1051), the subject matter of which was communicated to Minerals Separation, Ltd., by Mr. Higgins. In that specification, it is said (R., II, p. 1051, lines 6, et seq.):

"According to this invention the crushed ore is introduced into water containing *in solution*, a very small percentage of *aromatic hydroxy-compounds such as phenol, cresol,* salicylic acid or salicylates,

hydroquinone, picric acid, pyrogallic acid and also a small percentage of a mineral acid such as sulfuric acid, and the mixture is thoroughly agitated. The ore particles are caused to come into contact with a gas such as air; the result is to cause metallic sulphides to float and they can therefore be separated by any well known means."

The only subject matter that could have been the joint invention (assuming that there might have been invention) of Sulman, Higgins & Greenway, on February 1, 1909, is the use of the specific agents mentioned in the patent in suit and not mentioned in the earlier applications, namely, amyl acetate and other esters, benzoic, valerianic and lactic acids, acetones and other ketones such as camphor.

If plaintiff had been able to prove that Sulman, Higgins and Greenway jointly did some work that antedated the development by Higgins of the use of phenol and cresol in the froth-flotation process, and the development by Sulman of the use of alcohols in that process, then the patent might have been sustained, since a patentee in the United States is entitled, where originality of invention is in issue, to carry his date back to the earliest work he did abroad.*

But in answer to this defense, plaintiff offered no evidence of any kind, and contented itself with the suggestion that the defense is a technical one not favored by the courts. That we admit, in the sense that it is a

*On this aspect of the case—joint inventorship of Sulman, Greenway and Higgins—the Court should bear in mind that Higgins was continuously absent from England (being in fact in Australia) from August, 1908, until March, 1909 (R., I, 600), while Sulman and Greenway were each in England during this period (R., I, 600-601). It is impossible for us to conceive of these three gentlemen making a joint invention while so separated. The facts, as shown by the proofs in this case, are that there was *no joint invention or discovery of mineral-frothing agents in solution.*

statutory defense that may have the effect to destroy an otherwise meritorious patent. It is nevertheless a complete defense fully supported by the facts. Under the law of this country, a patent, to be valid, must be granted to the original or true inventor or inventors and if it appears that it was not so granted, nothing can save it.

In *DeLaval Separator Co.* vs. *Vermont Farm Mach. Co.*, 126 Fed., 536, the patent in suit was granted to Jules Melotte of Belgium and Wilhelm Reuther of Germany. Melotte under compulsion testified that he alone was the sole inventor. Judge Wheeler said (p. 537):

> "This [defense] is technical, but, as patents are founded solely upon statutes, they are not valid unless they comply substantially with all the terms and provisions of the statute."

He held the patent invalid, citing *Bannerman* vs. *Sanford*, 99 Fed., 294 C. C. A., 2nd Cir.

On appeal (135 Fed., 772), the Court of Appeals of the Second Circuit said:

> "The Court below adjudged the patent invalid upon the ground that the defense that Melotte and Reuther were not the joint inventors was satisfactorily established. With this conclusion we are constrained to agree, though we do so with regret, because the defense is purely technical, and destroys a meritorious patent, purchased by the complainant in ignorance of its infirmity, and at a very considerable price."

It is useless to review all the cases on the subject because the law is not disputed. If the proofs show that the invention was not a joint invention, the patent is invalid. In this case, the effective dates of the Higgins provisional specification and of the Sulman, Picard and

Ballot provisional specification are admitted and these provisional specifications leave no room for doubt that Higgins and Sulman, prior to the date of the alleged joint invention, knew how to use organic mineral-frothing agents—specifically "aromatic hydroxy compounds, such as phenol, cresol, salicylic acid or salicylates, hydroquinone, picric acid, pyrogallic acid" and "alcohols, such as amyl-alcohol"—in solution in the agitation-froth flotation process.

Attention is called, however, to:

Barrett vs. *Hall,* Federal Cases, 1047;
Stewart vs. *Tenk,* 32 Fed., 665;
Wellsbach Light Co. vs. *Cosmopolitan Incandescent Light Co.,* 104 Fed., 83;
DeLaval Separator Co. vs. *Vermont,* 135 Fed., 772;
Thropp & Sons vs. *DeLaski,* 218 Fed., 458; affirmed 226 Fed., 941,

and the cases cited in those opinions.

We respectfully submit that the evidence in this case conclusively establishes the fact that Sulman and Higgins, long prior to the alleged joint invention of the patent in suit, knew the very thing the patent purports to cover as the joint invention of Higgins, Sulman and Greenway, i. e., that the agitation froth process could be practiced with mineral frothing agents (particularly phenol, cresol, and certain alcohols) which existed in the pulp wholly in solution, and that, on this ground alone, the patent in suit must be held invalid.

We further submit that plaintiff has failed to present any sound reply to this defense because the defense is without flaw and unanswerable.

Fourth Defense.

Claims 1 and 2 of the patent in suit to which the complaint is limited are void because they attempt to claim more than the patentees had discovered or disclosed in the specification. These claims attempt to cover the carrying on of the process in any or all pulps (acid, alkaline or neutral) although the patentees had not discovered how to carry on the process except in an acidified pulp and the disclosure of the specification is that acid is a necessary, not merely a preferred, element of the process.

Fifth Defense.

The claims are not infringed because all claims based upon the supposed invention disclosed in the specification must be limited to the carrying on of the process in an acidified pulp; and defendant's pulp is not acidified.

These defenses are based upon lack of consideration for the monopoly claimed. The specification of the patent instructs that the agents be used in an acidified pulp; and nowhere suggests that they can be used in a neutral or alkaline pulp. The patentees say:

(Pat., p. 1, lines 15-22:)

> "According to this invention the crushed ore is mixed with water containing in solution a small percentage of a mineral-frothing agent * * * *and containing also a small percentage of a suitable acid such as sulfuric acid.*"

(P. 1, lines 39-41:)

> "The above mentioned mineral-frothing agents are all more or less effective *in the presence of an acid such as sulfuric acid* * * *."

(P. 1, lines 55-59:)

"Water containing a *small percentage of sulfuric acid in solution, say from* .2% to 0.5%, and containing in solution a small quantity, say 0.1% of one of the foregoing organic substances (say amyl acetate) * * *."

(P. 2, lines 61-64:)

"According to this invention the mineral-frothing agent consists of an organic compound contained in solution in the *acidified water.*"

(P. 2, lines 74-77:)

"We disclaim any such use of these substances and only claim them in such amount as will enable them to dissolve in the *acidified water.*"

The evidence shows affirmatively that the patentees did not know how to produce a mineral-bearing froth with any of these agents, except in an acidified pulp.

This is shown by the laboratory records of Mr. Stevens. He was employed in the laboratory of Sulman and Picard in London in the latter part of 1908 and the first part of 1909, and when so employed conducted a series of experiments upon the effects of a large number of substances as frothing agents in the agitation froth process, acting under instructions from his superiors. The results of these tests are shown in his contemporaneous notes and reports (R., I, p. 375, and Defendant's Exhibit No. 115, R., II, pp. 1107-1184).

The first report is dated December 11, 1908, and the last is dated June 7, 1909.

He started out experimenting with phenol, and in each case used acid in measured amounts. His report sheets (see for example R., II, 1107-9) show

"Circuit before test—0.7% acid,
Circuit after test—0.55% acid."

On December 30, 1908 (p. 1120), he reported tests on various other reagents experimented with "according to instructions received from Mr. Greenway." The data sheets show that he used a 0.6% solution of acid in each case.

The lists of substances experimented with included amyl alcohol, and in his report he says (p. 1122):

> "None of these reagents gave satisfactory results **unless acid was present.**"

On January 2, 1909 (p. 1123), he says:

> "I regret to say that with all the substances tried, no satisfactory result has been obtained, it appearing impossible to obtain a good clean-up of the mineral especially if large quantities of slimes are present **unless acid is added.**"

On January 9th he reported (p. 1131) a further series of tests with amyl alcohol and amyl acetate using an acid circuit in every test (pp. 1132-1134) and on the same day, in a second report, he said (p. 1135):

> "I beg to report results of series of tests carried out according to instructions received from Mr. H. L. Sulman, with the object of obviating the addition of either acid or oil to the pulps. No satisfactory result was obtained **unless acid was added** except in the case of Aniline Sulphate. * * * This material is distinctly acid to litmus, and may possibly contain some free Sulphuric Acid which accounts for this result."

On January 16, 1909 (p. 1141), he reported the results with various substances, including cresylic acid and cresol, and says:

"In trying these reagents without the addition of sulphuric acid, the results were very poor."

On January 24, 1909 (p. 1146), he reported the result of tests to determine the minimum quantity of acid which could be used with amyl alcohol solution:

"From the tests it appears that less acid is necessary to procure the desired effect than when Oleic Acid is the selective agent, and when the pulp is slightly warmed the cleaning up action is obtained with less acid than required in the cold. I am of the opinion that in the cold 15-20 lbs. of acid per ton would be necessary, whereas if warmed to about 35 C. good results should be obtained with 15.0 lbs. as a maximum."

In no case did he succeed in getting flotation without acid. His final conclusion, expressed in a report of June 7, 1909 (pp. 1183-4), was that amyl acetate

"is the best we have found amongst the many substances tried in the place of oil, * * *."

* * * * * * *

"The concentrates produced are very clean, and I feel confident in asserting that much less acid will be found necessary in conjunction with this reagent, in fact a very fair clean-up can be obtained when using sulfurous acid in the place of sulfuric acid."

Of course, this is language which would not have been used in a communication to Sulman & Picard if it had been known that the substances could be used without acid—that is, in a neutral or alkaline pulp.

On this evidence, the District Court found that the patentees of the patent in suit disclosed only an acid

pulp and did not know that the process could be used otherwise. The Court said (R., I, 623):

> "It is apparently true that the inventors disclosed an acid pulp and did not know that the process could be used otherwise."

The Court added:

> "It was widely understood at that time that nothing but an acid process would work in their concentration process, and it was the general custom to use an acidified pulp."

But that cannot be so because in the specification of patent 835,120 the Minerals Separation engineers had explained that in that process generally the acidification of the water was only a preferable step, not a necessary one.

The difference between that disclosure and the disclosure of the patent in suit was a deliberate difference and arose out of the fact that after prolonged attempts to operate in a non-acid pulp with the particular agents specified in the patent in suit the patentees had not been able to find any that would operate, except in an acid pulp.

In saying this, we are only saying what the plaintiff said to the Patent Office in prosecuting the Greenway flotation patent 1,099,699 of June 9, 1914 (R., II, 1248, et seq.), the so-called third patent of the Miami litigation. In the specification filed with the application for that patent, the alleged invention was said to be a modification of the invention described in the patent here in suit (962,678). The patentees saying (R., II, pp. 1291, lines 21-36):

> "The process therein described is applicable generally to the recovery of metallic sulfids and like

floatable metalliferous matter and in the case of lead and zinc sulfides to which the process has been largely applied **it is necessary for efficient working that the pulp should be slightly acidified**, and in most cases in practice the pulp is heated. It is now found that with copper ore such as an ore containing copper pyrites effective separation is obtained in the cold **without the use of acid** by employing as mineral-frothing agents, aromatic hydroxy compounds such as phenol, cresol, or mixtures containing the same."

In the second Patent Office Action (p. 1261) the claims of this application were rejected upon reference to the patent here in suit 962,678. To that Office action the applicant's attorney, Mr. Henry D. Williams, said (p. 1267):

"The present applicant participated in the invention disclosed in this patent [962,678] and the present invention is an important improvement upon that patent. **That patent discloses the employment of soluble frothing agents in an acid solution.** Phenol and its homologues are mentioned as such frothing agents, and it is said:

'The above mentioned mineral frothing agents are all more or less effective in the presence of an acid such as sulfuric acid' (Spec., p. 1, lines 30-42)."

• • • • • • •

"Since the making of the Solution invention, it has been discovered as the result of careful research and investigation, and quite contrary to the expectations of the metallurgists of Minerals Separation, Limited, that, if copper ores are treated *in neutral water* and with a minute quantity of an aromatic hydroxy compound or a material containing such a

compound, such as wood-tar oil, and submitted to the vigorous agitation characteristic of the agitation-froth process, a remarkable concentration may be attained."

(Page 1268:)

"It could not have been predicted from the patents cited, or, indeed, from any patents dealing with the problem of concentrating ores, that the remarkable results attainable by this new process were possible of attainment by the procedure covered in the present claims."

The Examiner was not satisfied and repeated his rejection (p. 1269).

To this further rejection Mr. Williams replied by filing affidavits of Mr. John Ballot and Mr. Greenway (one of the patentees of the patent in suit and also the patentee of Patent 1,099,699) and a further argument reviewing at some length the Minerals Separation's inventions and differentiating them from one another. He restates the substance of the Greenway affidavit, which relates to circumstances under which the supposed invention was made, and says (p. 1275):

"Ultimately the question appears to be whether or not, before he made the present invention, he disclosed it in these prior patents. He certainly did not do so in the Solution patent, since the **most that may be said of that disclosure is that it suggests the use of a phenol in an acidified solution, without heat.** It must be remembered that great ore-concentrating enterprises were being carried on in Australia with which Mr. Greenway was in direct contact, wherein a very considerable item of expense was the sulphuric acid essential in those processes. Indeed, it is char-

acteristic of all the Australian sulphide ores that they contain a considerable quantity of calcite and that necessarily considerable sulphuric acid is wasted in useless chemical reaction in the decomposition of this calcite, and therefore the acid consumption for all Australian ores was very high. It was, therefore, highly desirable to save this item of expense, **and yet that saving was deemed to be impossible.** Another important factor was that a great litigation was pending wherein the owners of the Elmore patents were asserting that their Australian patent, corresponding to United States Patent No. 689,070, was a master patent for the use of sulphuric acid in any process wherein oils were employed in the concentration of ore. Had the Elmores prevailed in this suit, enormous sums in damages would have been collected and a great industry would have been held in subjection.

* * * * * * *

There was, therefore, during the entire period from the Solution invention to the discovery of the present invention the **strongest possible incentive to the omission of acid.**"

He then proceeded to make the argument that if the possibility of omitting acid had been known to the patentees of the patent in suit or discoverable by men skilled in the art from the disclosure of the patent in suit, the acid would have been omitted and all of these expenses saved.

His remarks make plain the purpose of Mr. Stevens' investigation and confirm the fact that it resulted in a failure to float ore with any of the substances named in the patent in suit, except in an acidified pulp.

The Greenway affidavit (pp. 1282-8) asserts of the Solution patent here in suit that

> "• • • the important discovery there set forth is that the agitation-froth process may be carried on **in an acidified pulp** containing in solution a mineral-frothing agent as distinguished from the disclosures of the original agitation froth process patent No. 835,120."

• • • • • • •

> "The present invention was made by me subsequent to my participation in the Solution and in the Essential Oils inventions above referred to. **It was not suggested to me by those inventions.** It was, in fact, a discovery unexpected and surprising."

Plaintiff through its counsel then represented that after the disclosure of the patent in suit it still required invention to use these frothing agents (phenol and cresol and the other substances mentioned in the patent in suit) in the flotation of copper ores without acid; yet now plaintiff contends that anyone would know, upon reading the disclosure of the patent in suit, that these substances could be used as well in a neutral or alkaline pulp.

As this Court said in the *Butte Case* (250 U. S., 344-345):

> "Much of this evidence is especially impressive because the papers from which it is derived were written and the witnesses testified before the question • • • , now made in this case, was raised or discussed."

The District Court, in its opinion, said on this question (R., I, 624):

> "Even if the patentees did not know that the process described by them could be carried on with an alkaline pulp they did not limit themselves in that respect and it is sufficient if the real novelty of their invention is broad enough to support the claims, as it appears to be."

But that seems to us a strange way to judge the *quid pro quo* that must be delivered by a patentee to the public as compensation for the granted monopoly. What the patentee has really added to the sum of human knowledge in the sense of its practical availability in the arts, he is entitled to monopolize by a patent. Here, leaving aside the question of anticipation hereinabove discussed, what the patentees stated to the men skilled in the art was that if they used these soluble substances in an acidified pulp, those substances would go wholly into solution in the pulp and would produce a mineral-bearing froth. Beyond that the disclosure did not go; and we do not see how the monopoly can be extended beyond the disclosure.

In sharp contrast with the disclosure of patent No. 835,120, the patent here in suit sets forth the use of acid, not as a recommendation of preference, but as a necessary element of the process. In *Snow* vs. *Lake Shore, etc., Railway Co.* (121 U. S., 617, at p. 630) this Court said, expressing a well-established rule:

> "It is not admissible to adopt the argument made on behalf of the appellants, that this language is to be taken as a mere recommendation by the patentee of the manner in which he prefers to arrange these parts of his machine. There is nothing in the con-

text to indicate that the patentee contemplated any alternative for the arrangement of the piston and piston rod. The arrangement of the valves, as shown in the drawings, he declared not to be essential, and explained how they might be otherwise adjusted, and the comparative advantage and disadvantage of those plans; but no such language is used in reference to the connection between the piston and its rod."

This being so, claims 1 and 2 of the patent in suit, which are not limited to an acidified pulp, attempt to claim more than the patentees had discovered or disclosed, and are therefore invalid.

Defendant's Practice.

In defendant's practice there is added to the ore pulp a small quantity of a mineral-frothing agent which goes wholly into solution in the pulp. But that mineral-frothing agent is not any of the substances mentioned or suggested in plaintiff's patent, or anything that was known at the time of plaintiff's patent to have preferential affinity for metalliferous matter. The agent used by defendant is alpha naphthylamine, commonly known as X-cake. It is a flotation agent discovered and patented by plaintiff's licensor, Metals Recovery Company (Patent No. 1,228,183, of May 29, 1917, R., II, 1222; and see Stipulation, R., I, 105, and License Agreement, R., II, 1238).

The substances mentioned in plaintiff's patent have not had any considerable place in the industrial use of the flotation process. Industrially the art has used principally wood-tar and coal-tar oils. The only mineral-frothing agent going wholly into solution in the pulp that has had any extended industrial use is alpha naphthylamine, developed by defendant's licensor.

Defendant's pulp is not acidified. On the contrary, it is made alkaline by the addition of lime. Defendant's use of an alkaline pulp is not, in any sense, a practice adopted for the purpose of avoiding the claims of the patent in suit. The testimony of Mr. Nichols (R., I, 373-374) shows that the defendant's mill is operated on an alkaline pulp because satisfactory recovery of the minerals cannot be effected on its ore with its process unless the pulp is alkaline.

It is, therefore, respectfully submitted that defendant does not infringe claims 1 and 2 of the patent in suit, since these claims are of necessity limited to an acidified pulp, both by the disclosure of the patent itself and by the state of knowledge of the patentees as established by the evidence.

Plaintiff's Reply to the Fourth and Fifth Defenses.

In replying to these defenses, plaintiff cited in the Court below, many cases to the effect that broad claims in a patent are not to be restricted to specific details set forth in the specification. With this we agree. If the specification discloses one or more specific ways of doing the thing, the claims may be broad enough to cover all of those ways of doing it and their equivalents, but where the specification does not disclose, and the patentees did not know, how to use a soluble frothing agent in a non-acidified pulp, they cannot cover that by any claim language. Claims covering, in broad phraseology, the disclosure of the specification are not to be limited to the specific means disclosed. On the other hand, the monopoly cannot be extended by broad claim language to cover something not disclosed in the specification.

It was said by Judge Hough, speaking for the Circuit Court of Appeals for the Second Circuit in *Westinghouse* vs. *Metropolitan Electric Mfg. Co.*, 290 Fed., 661, May 7, 1923, page 664:

"What any patentee has invented is theoretically what he discloses, and the disclosure is the specification. A claim is a definition of that which has been described in the specification. A disclosure tells how to do that of which the claim attempts definition. * * * A claim not supported by the specification is a bad claim."

The doctrine is, in fact, well enough illustrated in the opinion of this Court in the *Hyde Case* on patent No. 835,120. Claims 9, 10 and 11 of that patent were broadly for the use of a "small quantity" of mineral-frothing agent. The other claims were limited to "a fraction of one per cent." Claims 9, 10 and 11 were, therefore, broader than the other claims and plaintiff urged there, as it does here, that to restrict claims 9, 10 and 11 to a fraction of one per cent. would be to give them the same meaning as the other narrower claims. This Court declared the broader claims invalid, thereby applying and illustrating the rule that a patent can never be broader than the invention—a rule that may be thought of as *the* fundamental rule of the patent law, the whole purpose of which is to secure to inventors a monopoly of what they invent, and not of something else.

Sixth Defense.

The claims are not infringed by defendant's process because the claims were deliberately limited by the patentees to a process in which the froth is formed by agitation, and defendant uses the pneumatic bubble column flotation process in which the froth is not formed by agitation.

This defense is based upon the statutory requirement (U. S. C., Tit. 35, Sec. 33; R. S., Sec. 4888) that the pat-

entee "shall particularly point out and distinctly claim the part, improvement, or combination which he claims as his invention or discovery."

Defendant's position is that the words "agitating the mixture to form a froth" in the claims of the patent define and are limited to such a process of froth flotation as is described in patent 835,120, wherein *by agitation* air is introduced into the pulp to form the froth. The patentees of the patent in suit, engineers of Minerals Separation, Ltd., knew all about the agitation-froth process of patent 835,120 and all about the several other known froth flotation processes in which the froth-forming gas was not introduced into the pulp by agitation, but was otherwise "liberated in, generated in, or effectively introduced into the mixture." The patentees of the patent in suit deliberately chose the expression "agitating the mixture to form a froth" to differentiate it from these earlier processes. And defendant does not infringe because it uses a subsequently invented process in which air is not introduced into the pulp by agitation but is gently released therein under light pressure through the porous bottom of the pneumatic flotation cell.

It does not answer this proposition to say that plaintiff might have demanded and received a patent for the use of mineral-frothing agents in solution in every froth flotation process, no matter how the gas might be introduced into the pulp. The rule of the patent law is that the claims as granted measure the extent of the monopoly.

From the earliest days, although the purpose of the law to fully reward the inventor has always been kept in mind, this Court has held that the public interest must also be considered and that, even though the language of the claim is narrower than the true invention, the patentee will, nevertheless, be limited to the scope of the monopoly claimed; since to do otherwise would be unfair

to the public and would give rise to hidden liens and unknown liabilities which would more than offset the hardship to inventors which may arise out of the application of the rule.*

That being the law, the facts are, defendant contends, that the words "agitating the mixture to form a froth" of the claims here in issue were words of recognized significance to the man skilled in the art, including the patentees of the patent here in suit; that those words meant the agitation froth process—the process of patent 835,120, or its equivalent—and excluded other froth flotation processes: and that the patentees of the patent here in suit deliberately chose them for that purpose.

These are the very words which the same patentees used in the broadest claims (9, 10 and 11) of their patent 835,120, and they have the same meaning as the words used in the other claims of that patent—"agitating the mixture until the oil-coated mineral matter forms into a froth."

The record shows that these men knew all about (1) the boiling process (Sulman U. S. Patent 835,143), in which the bubbles of air and water vapor were generated in the body of the pulp by boiling; (2) the chemical generation process (Froment British Patent 12,778 of 1902, for example, and the Potter and Delprat process of U. S. Patents 735,071, 768,035 and 776,145), in which the bubbles of gas were generated in the pulp by chemical reaction; (3) the Elmore vacuum process (Patent 826,411), in which bubbles of air were liberated in the body of pulp by a vacuum; (4) the plus-pressure process

*_White_ vs. _Dunbar_, 119 U. S., 47, at page 51; _Lehigh Valley Railroad Co._ vs. _Mellon_, 104 U. S., 112, at page 118; _McClain_ vs. _Ortmayer_, 141 U. S., 419, at page 423; _Merrill_ vs. _Yeomans_, 94 U. S., 568, at page 573; and _Minerals Separation, Ltd._, vs. _Butte, etc., Mining Co._, 250 U. S., 336, at page 347.

(Plaintiff's U. S. Patents 835,120 and 835,479), in which additional air was dissolved in the pulp by a preliminary compressing operation and was then released to form the flotation bubbles by relieving the pressure; and (5) the agitation-froth process of Patent 835,120.

All of these processes are included within the generic expression "a gas is liberated in, generated in, or effectively introduced into the mixture." But the specific expression "agitating the mixture to form a froth" defines only the agitation froth process of patent 835,120.

In the specification of the patent in suit, the patentees, with their intimate knowledge of these prior processes and just how the gas was introduced in each, said that in their process of the patent in suit (R., II, 664, lines 23-25)

> "the mixture is thoroughly agitated; a gas is liberated in, generated in, or effectively introduced into the mixture."

That expression, as it stood, without more, might have been interpreted to mean either "the mixture is thoroughly agitated (and thereby) a gas is liberated in, generated in, or effectively introduced into the mixture," or it might be interpreted that for the purpose of forming the froth "the mixture is thoroughly agitated (or in lieu of agitation) a gas is liberated in, generated in, or effectively introduced into the mixture."

But when it came to *claiming* their invention, the patentees deliberately chose between these two possible things and expressly limited their claims to "agitating the mixture to form a froth." Having the definition clearly in mind, they deliberately chose to limit their claims to the agitation froth process in which the agitation introduced air into the pulp and formed the froth. No doubt they then believed that process to be of controlling importance in the industry (the Pneu-

matic-Flotation process used by defendant had not then been invented) and preferred to limit their claims to that; thereby adding to the claims whatever strength inheres in the more specific basis for the monopoly. We submit that the choice made then cannot now be departed from.

Plaintiff's counsel said, in argument in the Court below, that he could think of no broader way of stating the invention than in the words "agitating the mixture to form a froth," but it is obvious that the patentees knew how to state it more broadly. If it had been their purpose to claim broadly the use of mineral-frothing agents in solution in any and all of the then-known frothing processes, the proper language lay right on their tongues. All they had to do was use the unqualified expression "effectively introducing a gas into the mixture to form a froth." Having chosen not to make that claim during the prosecution in the Patent Office, they cannot make it now.

In the process of flotation claimed in the patent in suit air is sucked and beaten into the pulp and the mineral-bearing froth is formed in the pulp by agitation. In the pneumatic flotation process the pulp is aerated by a multitude of minute bubbles forced through the porous bottom of the pneumatic flotation apparatus, the froth is formed without other agitation than the mere upward movement of the bubbles through the pulp, and the concentration occurs not in the body of the pulp but in the bubble column above it.

These differences are clearly brought out in the record in this case, more particularly in the testimony of Professor Taggart at R., I, 256.

That testimony establishes, we think, that the principle of the two processes, and their mode of operation to effect concentration of the mineral, are essentially different.

The difference cannot be summarily expressed better than it was expressed in the opinion of the Court of Appeals of the Third Circuit in the *Miami Case* when the Court said of the Pneumatic Flotation process (which this defendant uses):

> "* * * aeration is direct and is not the result of or caused by agitation. On the contrary, agitation results from aeration, and such agitation, though present in some measure, is not even approximately of the violence and duration of the agitation of the patent" (244 Fed., 767).

As to the meaning of the words "agitating the mixture to form a froth," both in their physical significance and in their monopolistic scope, the conclusions of the Court of Appeals of the Third Circuit are in accord with defendant's contentions here, and opposed to plaintiff's contentions.

And it should be noted that this was the question of all absorbing importance in the Court of Appeals of the Third Circuit. It was on the meaning to be attributed to the words "agitating the mixture to form a froth" that the whole case turned, with respect to both patents in that Court.

In that case the defendant was using, in the last step of concentration, the Callow pneumatic cells which defendant uses here. The charge of infringement there rested upon a pre-agitation of the pulp before the pulp arrived at the pneumatic cell. The Court divided as to whether or not there was, in the practice of the Miami Copper Company, pre-agitation equivalent to the Gabbet mixer agitation of the patents. But it is clear, not only from the general discussion but from the actual statements of the Court, that all three members of the Court regarded the process of flotation within the pneumatic

cell itself as something different from and outside of the agitation froth process of the Minerals Separation patents.

The opinion of the Court of Appeals of the Third Circuit was founded upon the decision of this Court in the *Hyde Case*. Analyzing the invention of patent 835,120, in that case, this Court found that it involved "an agitation greater than and different from that which had been resorted to before" (242 U. S., 268-9). It is clear that the words of the claims in that case—"agitating the mixture to form a froth" and "agitating the mixture until the oil-coated mineral matter forms into a froth"—were construed to mean that agitation which distinguished this process from the prior art processes—that is, an agitation different from and greater than the agitation of the processes which had preceded it.

In the *Miami Case*, the Court of Appeals, adopting this Court's interpretation of these words, which appear in the claims of the patent here in suit as well as in the claims of patent 835,120, proceeded to consider the question of infringement of the claims of the two patents. Thus, the Court of Appeals said (244 Fed., 757):

> "Shortly thereafter the Supreme Court [in the *Hyde Case*] * * * held the patent valid, finding invention, as we read the opinion, in the co-action of the critical proportion of oil and air effected by 'an agitation greater than and different from that which had been resorted to before,' resulting in a froth concentrate of economical value."

(p. 763:)

> "Agitation 'to cause' a froth or agitation 'until' a froth is formed, being the disclosed means of the patent to produce the phenomenon of the critical

quantity of oil, and aeration without agitation being the defendant's claimed means of causing or obtaining the same phenomenon from the same critical proportion of oil in the form of an evanescent foam, the controversy revolves around the elements of aeration and agitation."

After finding that the defendant agitated the pulp before it was admitted to the pneumatic cell by three steps (which are referred to together as pre-agitation) they said of the fourth step (the operation in the pneumatic cell):

(p. 767:)

"It is equally true that in this fourth step, aeration is direct and is not the result of or caused by agitation. On the contrary, agitation results from aeration, and such agitation, though present in some measure, is not even approximately of the violence and duration of the agitation of the patent. The operation in the Callow cell certainly possesses these distinguishing features from operation of the process where aeration is caused by agitation."

• • • • • • •

(p. 768:)

"If the only agitation to which the pulp was subjected (after such agitation as in the prior art was necessary to mix the oil and ore) was the agitation of the Callow cells, we would not say that that agitation amounted to or was the equivalent of the violent agitation of the patent disclosure and constituted infringement."

Of the patent here in suit, the Court said:

(p. 774:)

> "The real question upon this patent also is the question of infringement, and here as well as there the decision turns upon the kind and degree of agitation employed by the defendant."

The Court then pointed out that in the patent here in suit:

(p. 774:)

> "* * * the agitation of the second process [962,678] is so described as to cover expressly a wider range of means and degree than is expressly covered by the first process [835,120], and therefore needs less aid, if any, from the doctrine of equivalents."

There is certainly not to be read into this closing remark of Judge Woolley any suggestion that he thought the second patent was not limited to "agitation to form a froth" or that it would be infringed by the pneumatic process in which, as he says (p. 767):

> "* * * aeration is direct and is not the result of or caused by agitation."

To read that into it would make it contradict his immediately preceding remark that

> "here as well as there the decision turns upon the kind and degree of agitation" (p. 774).

Comparison of the majority opinion with the dissenting opinion in the *Miami Case* shows that the disagreement among the Judges was not with respect to the conclusion of this Court (that the agitation-froth process differed from the prior art in the degree of agi-

tation different from and greater than the agitation of the prior art), but was as to what particular degree of agitation was the equivalent of the agitation of the patents there in suit. Judge Buffington was of the opinion that the agitation-froth process had to be restricted to mechanical agitation, whereas the majority of the Court, although they admitted it had to be "differen from and greater than" the agitation of the prior art, felt that it did not necessarily have to be mechanical agitation so long as it was "agitation to form a froth."

When the majority said that in the pneumatic process aeration "is not the result of or caused by agitation," they were to that extent agreeing with Judge Buffington. True, this was *dicta*, not judgment. But it is very persuasive *dicta*, coming after the painstaking and conflicting consideration given to the question by the Judges of that Court.

We, therefore, respectfully submit that defendant does not infringe claims 1 and 2 of the patent in suit, since these claims are specifically limited to a process in which the froth is formed by agitation, whereas defendant uses the pneumatic flotation process in which the froth is not formed by agitation.

Respectfully submitted,

WILLIAM H. DAVIS,
MERTON W. SAGE,
Counsel for Respondent-Defendant.

Dated, New York, N. Y., November 25, 1929.

APPENDIX.

"Oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue" known in the art and specifically mentioned in the following patents published prior to the filing of the application for patent 835,120.

Haynes, British Patent 488 of 1860, R., II, 923.

"bituminous matter (coal tar from gasworks, and such like, for instance), gums or gummy matter (amongst others, gutta percha, india-rubber, for instance), and fatty or oleaginous matter" (p. 925, lines 8-11).

"common resin," "coal tar," "oil or fatty matter" (p. 926, lines 6, 9).

Bessel, German Patent 42 of 1877, R., II, 929.

"1. All fatty oils and solid fats of the animal and vegetable kingdom, and the fatty acids obtainable therefrom.
"2. All essential oils.
"3. All resins of the vegetable and mineral kingdom, their solutions, and the oils obtainable from them by dry (destructive) distillation.
"4. The caoutchouc bodies, their solutions, and the oils obtainable therefrom by dry (destructive) distillation.
"5. The so-called balsams of commerce.
"6. Crude and refined petroleum, the by-products of the refining process, the more volatile ones, such as ligroin, petroleum spirit and petroleum ether, as well as the less volatile ones, the so-called vulcan and machine oil.
"7. Tar from brown coal, anthracite coal, wood and peat, and also the oily products of the distillation of these tars, as well as the residues remaining after distillation.
"8. Pitch of commerce.
"9. Paraffine wax.

"10. Benzine.
"11. Potato fusel oil.
"12. Beeswax and vegetable wax, also oils obtainable therefrom by dry (destructive) distillation.
"13. Mineral oil and mineral tar.
"14. Ozokerite.
"15. Spermaceti.
"16. Bone oils obtainable by dry (destructive) distillation, as well as by the boiling of bones.
"17. Cheeses of commerce.
"18. Finally, mixtures and solutions among each other, of the bodies heretofore referred to."

Bessel, German Patent 39,369 of 1887, R., II, 932.

"bitumens"; "crude and refined petroleum, the by-products of the refining process, paraffine, benzine, mineral oil, mineral tar, ozokerite"; "hydrocarbons in solid and liquid state, fusel oils, etc." (pp. 933-934).

Everson, U. S. Patent 348,157, 1886, R., II, 935.

"a fat or an oil, either animal, mineral or vegetable, or a fatty constituent or acid of an animal or vegetable fat or oil, or any constituent of a mineral oil" (lines 17-20), "petroleum";"paraffine-oils";"tallow (melted), lard, lard-oil, red oil (impure oleic acid), cottonseed-oil, castor-oil, sperm oil, and linseed-oil" (lines 81-85).

Sutton, British Patent 24,144 of 1892, R., II, 938.

"a cheap mineral oil such as kerosene"; "a volatile hydrocarbon fluid or a resin preferably of turpentine" (lines 19, 22).

Robson & Crowder, British Patent 427 of 1894, R., II, 940.

"a mixture of a liquid hydrocarbon such as turpentine, petroleum, paraffine or the like and a fatty oil, such as colza oil" (lines 26-28).

Elmore, U. S. Patent 703,905 of 1902, R., II, 953.

"This invention relates to apparatus for effecting the separation of minerals by the selective action of oils and like substances" (lines 10-12). "In what follows I shall use the word 'oil' to mean either oil or any other substance that can exert a selective action on minerals such as oil exerts" (lines 17-20); "tar, heavy residuum oils" (line 92).

Froment, British Patent 12,778 of 1902, R., II, 959.

"fatty substance"; "ordinary oil"; "suitable oil."

Cattermole, British Patent 26,295 of 1902, R., II, 962.

"The present invention relates to improvements in the separation of the metallic constituents of ores from gangue by means of the selective action of oils on minerals" (lines 4-6).

"Any animal, vegetable or mineral oil may be used, which alone or in conjunction with an emulsifying agent has the property of picking up metallic mineral particles; for example linseed oil, lard, paraffine or light hydrocarbon oil; heavy hydro-carbon oils, preferably mixed with a fatty acid or fatty oil" (lines 26-29).

Cattermole, U. S. Patent 763,259 of 1904, R., II, 966.

"The present invention relates to the classification of the metalliferous constituents of ores which have been separated from gangue by oil or similar matter, such as certain wood or coal tar products, hereinafter referred to as 'oil,' in which term I also include the emulsifying agent when an emulsifying agent is present with the oil" (lines 9-16).

Cattermole, U. S. Patent 763,260 of 1904, R., II, 970.

"The present invention relates to improvements in the separation of the metalliferous constituents of ores and the like from gangue by means of the selective action of oils and certain tar products or similar compounds (all hereinafter referred to as 'oil') on metallic or metalliferous matter" (lines 12-18).

"The oil used may be animal, vegetable, or mineral oil, or mixtures of these, or such coal or wood tar products or other substances which exercise, like oils, a preferential physical affinity for metallic mineral matter as distinguished from gangue" (p. 971, lines 89-94).

"In some cases, as with wood-tar and some coal-tar products, these when agitated in weak alkaline solutions provide their own emulsifying agents, soluble resinates, cresylates, etc., being thereby formed, which emulsify the bulk of the tar or product.

"Emulsification in some cases, as with the heavier residuum oils or tars, may be assisted by first mixing therewith a small amount of fatty oil or fatty acid" (p. 971, lines 103-113).

Cattermole, U. S. Patent 777,273 of 1904, R., II, 974.

"The 'oil' used may be animal, vegetable, or mineral oil or mixtures of these or such coal or wood tar products or other substances which exercise, like oils, a preferential physical affinity for metallic mineral matter as distinguished from gangue" (p. 975, lines 89-94).

"wood-tar"; "coal-tar"; "fatty acid"; "residuum oils or tars" (p. 975, lines 105-122).

Cattermole, Sulman & Picard, British Patent 17,109 of 1903, R., II, 978.

"resin—or fatty—acids, or * * * other aromatic derivatives (such as cresols, phenols, etc., * * *)" (lines 9-10).

"fatty—or resin—acid or other compound such as cresol etc." (line 20).

Cattermole, Sulman & Picard, U. S. Patent 777,274 of 1904, R., II, 982.

"fatty or resin acids or * * * other aromatic derivatives (such as cresols, phenols, etc.)" (lines 15-16).

Cattermole, Sulman & Picard, U. S. Patent 788,247 of 1905, R., II, 984.

"Our process * * * is dependent upon the superior physical attraction exhibited by minerals for fatty or resin acids or for certain other aromatic derivatives—such as cresols, phenols, etc.— * * *, as compared with earthy or silicious substances" (lines 9-18).

Sulman & Picard, U. S. Patent 793,808 of 1905 (filed Oct. 5, 1903), R., II, 991.

"oils, grease, tar, or any similar substance which has a preferential affinity for metalliferous matter over gangue" (lines 13-15).

"According to this invention we utilize the power which is possessed by films or bubbles of air or other gas of attaching themselves to solid particles moistened by oil or the like" (lines 16-19).

"oil, grease or tar (hereinafter referred to as 'oil')" (lines 23-24).

"This process has been described as applied to ore concentration by oil; but it is to be understood that it is equally applicable to concentration by the use of any other substance which has an affinity for metalliferous matter" (p. 992, lines 67-71).

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MAR 21 1930
CHARLES ELMORE CROP

Supreme Court of the United States

OCTOBER TERM, 1929.

No. 71.

MINERALS SEPARATION NORTH AMERICAN CORPORATION,
Petitioner,
—vs.—
MAGMA COPPER COMPANY,
Respondent.

PETITION FOR REHEARING.

TO THE HONORABLE THE CHIEF JUSTICE AND THE ASSOCIATED JUSTICES OF THE SUPREME COURT OF THE UNITED STATES.

Your petitioner, Minerals Separation North American Corporation, respectfully represents as follows:

I. That the decision of this Court filed February 24, 1930, overlooks two principles of law established by many adjudications of this Court, namely

(1) That an improvement of an art or process may be patentable as well as the art or process itself, and

(2) That to anticipate a patent a prior patent must describe the invention in suit in such full, clear and exact terms as to enable anyone skilled in the art to practice it without the exercise of invention.

II. That facts recited in the opinion as leading to the conclusion of anticipation reached are contrary to the evidence.

I.

The Errors of Law.

1. U. S., R. S. 4886, includes as patentable not only "any new and useful art" but also "any new and useful improvements thereof."

Eibel Process Co. v. *Minnesota & Ontario Paper Co.*, 261 U. S. 45, 63.

This Court in finding anticipation of the patent in suit by the disclosures of patent No. 835120, holds that the disclosure of 835120 is a general one having to do with reduction in the quantity of the agent used and is not limited to the use of any particular agent or class of agents.

Even so, there is no disclosure in that patent of the use of a mineral-frothing agent in solution or of the different mode of operation, the superior advantages and the different results of such an agent in ore concentration.

The patentees of the patent in suit 962678 were the first ever to use a mineral-frothing agent in solution (to wit, in December, 1908) and they discovered that such an agent had a superior advantage over oleic acid, the insoluble exemplar disclosed in 835120, and which had been alone theretofore used in commercial operations of froth flotation.

They discovered that it produced a froth superior to the froth produced in that example and produced that froth by an operation different from the coating operation described in connection with that example in 835120, and it turned out eventually that such a mineral-frothing agent in solution successfully concentrated an important class of ores (porphyry copper ores) which could not then and cannot now be successfully concentrated by oleic acid or by any other insoluble agent.

(a) That the froth produced by a mineral-frothing agent in solution is distinguishably different from the froth produced in the example given in 835120 is testified to by petitioner's

expert and is not denied by respondent's (R. Vol. I, p. 401, Qs. 43, 44; main Brief for Petitioner, pp. 31, 32).

The fact that mineral-frothing agents in solution modify the water so that great quantities of very small bubbles are formed may be observed by the Court by vigorously shaking the bottles, Plaintiff's Exhibits 27-31, inclusive, which were filed at the argument (if there is air in the bottle), in contrast with a bottle of plain water which was included with them for the purpose.

(b) That the mode of operation (in forming the froth) described in 835120 in connection with the example there given is different from the mode of operation in forming the froth in the improved process with a mineral-frothing agent in solution, appears from the fact that in the one case (835120) the metalliferous mineral particles are coated by the agent used whereas in the other case (962678) they are not, and by the further fact that in the one case (835120) the air bubbles that form in the unmodified water attach themselves only to coated metalliferous mineral particles whereas in the other case (962678) the air bubbles that form in the modified water attach themselves to uncoated metalliferous mineral particles.

The action of the agent in relation to the metalliferous mineral particles is different in the two cases, and the action of the air bubbles in relation to the metalliferous mineral particles is different in the two cases.

(c) Both of these propositions of difference, to wit in the froth, and in the way in which the froth is formed, are shown to be significant and substantial by the difference in the practical usefulness of the two processes.

The improved process using a mineral-frothing agent in solution is so different that the porphyry copper ores, the world's present greatest source of copper, are amenable to it, whereas they have not been, and are not, amenable to the first froth-flotation process as exemplified in 835120 (see main Brief for Petitioner, pp. 46-52).

Here, we respectfully submit, are all the elements of a patentable "improvement" over and above the discovery disclosed in 835120 as that discovery is defined in the opinion of this Court in the instant case (page 3, second paragraph, lines 1-4):

> "that a very minute portion of the oil worked in an unexpectedly different way from that familiar with larger quantities—not in the matter of coating the particles, but in helping to produce a froth that floated instead of granules that sank * * *."

The discovery disclosed in 962678 added to this the further conception that with a mineral-frothing agent in solution the mineral-bearing froth that floated would be different and better for ore concentration purposes and would be applicable to a wider range of ores and to more difficult ores and particularly to porphyry copper ores.

2. That a prior patent to anticipate must certainly and without any doubt or peradventure describe in its entirety the discovery and improvement of the patent in suit is established law in this Court.

In *Seymour* v. *Osborne*, 78 U. S., 516, 555, Mr. Justice Clifford said:

> "Mere vague and general representations will not support such a defense, as the knowledge supposed to be derived from the publication must be *sufficient to enable those skilled in the art or science to understand the nature and operation of the invention*, and to carry it into practical use." (Italics ours.)

In *Cohn* v. *Corset*, 93 U. S. 366, 370, Mr. Justice Strong said:

> "It must be admitted that, unless the earlier printed and published description does exhibit the later patented invention in such a full and intelligible manner as to enable persons skilled in the art to which the invention is related to comprehend it without assistance from the patent, or to make it, or repeat the process claimed, it is insufficient to invalidate the patent."

This rule was affirmed in *Downton* v. *Yeager Milling Co.*, 108 U. S. 466, 471, and in *Eames* v. *Andrews*, 122 U. S. 66. See also *Railroad Co.* v. *Turrill*, 94 U. S. 695, 704.

In *Carnegie Steel Co.* v. *Cambria Iron Co.*, 185 U. S. 403, 420, Mr. Justice Brown said of a prior patent:

> *"It is sufficient to say of it that it fails to disclose, fully and precisely, the essential features of the process covered by the Jones patent."* (Italics ours.)

We believe and submit that in the case at bar this Court has found anticipation where the certainty required does not exist. But this proposition will become more manifest when we have dealt with the errors of facts in the opinion.

II.

The Errors of Fact in the Opinion.

I. The opinion says of the disclosure of 835120 (p. 3, lines 8 and 9 from the bottom):

> "No particular oil was mentioned * * *."

This was of course an oversight because the patent (835120) gives a specific example and explicitly names a particular agent. The patent says (R. Vol. II, p. 1004, lines 70-72):

> "The following is an example of the application of this invention to the concentration of a particular ore."

The particular ore is a lead-zinc ore. The particular oil or oily substance mentioned is oleic acid, a fatty acid which is an oily liquid (R., Vol. II, p. 1004; patent, p. 1, line 80).

The description of the example extends to page 2 of the patent, line 8 (R., Vol. II, p. 1005), and that example is specifically claimed in claims 5, 6 and 7 (R., Vol. II, p. 1006, lines 83-112).

Whether the disclosure of 835120 includes anything other than oleic acid is a matter of inference from other language to be later considered.

The practical importance of the particular oil mentioned by way of example is that the discovery of 835120 was made while using that particular oil in the Cattermole metal-sinking process as related in the decision of this Court in the *Hyde* case (242 U. S. 261, 266, 267). The importance of the matter is shown also by the fact that all commercial froth-flotation operations in the world up to about July, 1912, were conducted with that particular oil (main Brief for Petitioner, p. 46).

2. The opinion of this Court in the instant case says (p. 3, lines 14 and 15):

> "It is a matter of reasoning rather than of observation that the oil coats the mineral particles."

This was an error of fact.

There is no doubt but that the writer of both specification and claims of 835120 believed that the oleic acid, or other oily substance used, actually coated the mineral particles and not the gangue particles. This appears in the statement of the discovery (patent, p. 1, line 33; R., p. 1004)[1]; in the statement of the operation (p. 1, line 96, R., p. 1004)[2]; in the statement of the result (p. 2, line 4, R., p. 1005)[3]; in all the claims (p. 3, lines 46, 57, 67, 78, 89, 99, 110, 121, 129, R. 1006, and p. 4, lines 5, 11, 19, 23, 41, R., p. 1007), and in numerous other places.[4]

In the Appendix we analyze the art prior to 835120 in this regard and demonstrate the universal belief and acceptance of the fact, that an oil, or oily substance, like oleic acid, actually coats the mineral particles. We ask the Court to read the

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[1] "oil-coated metalliferous matter"

[2] "such bubbles or air-films adhering only to the mineral particles which are coated with oleic acid"

[3] "oil-coated metalliferous matter"

[4] The patent refers to the oleic acid "forming the coating on the metalliferous matter which produces the froth" (p. 2, lines 13-16). It describes a method for the recovery of "sunk oiled metalliferous matter" (p. 2, line 104). It refers to "a thin coating of oil on these mineral particles for which oil has an affinity" (p. 2, lines 128, 129). It refers to the act of coating as "oiling" (p. 1, line 37), and refers to the oil-coated minerals as the "oiled mineral." It speaks of the use of acid "to prevent gangue from being coated with oily substance" (p. 1, lines 41, 42).

Appendix at this point. It is, we believe, conclusive of the matter.

It was this prior art that this Court in the *Hyde* case summed up when it said (242 U. S. 261, 266):

> "It is clear that in the prior art, as it is developed in this record, it was well known that oil and oily substances had a selective affinity or attraction for, *and would unite mechanically with*, the minute particles of metal and metallic compounds found in crushed or powdered ores, but would not so unite with the quartz, or rocky non-metallic material, called 'gangue.' Haynes British patent (1860), and the United States patents, Everson (1885), Robson (1897) and Elmore (1901)." (Italics ours.)

The fact that the oleic acid does not dissolve in the water of the ore pulp but remains in undissolved globules therein until it coats the mineral, is not seriously denied by Respondent's experts. One of them admitted that the solubility of ordinary glass "is of the same order of magnitude as the oleic acid" as used in the process (R., Vol. I, p. 371, RXQ. 143), and the other asserted that "glass certainly would not be considered soluble for the purposes of flotation" (R., Vol. I, p. 211, Q. 38).

Petitioner's proofs demonstrated the fact that oleic acid coats the metalliferous mineral particles, and did so not by reasoning but by observation and by experiments and demonstrations, chemical and physical, more conclusive than observation (main Brief for Petitioner, 53-55).

That the metalliferous mineral particles in the froth are actually coated with oleic acid is further demonstrated by the fact of the possibility of removing the coating of oleic acid from those particles by the use of a dilute solution of caustic alkali. This is described in the specification of patent 835120 (p. 2, lines 3-8; R., Vol. II, p. 1004) and in claim 4 (p. 3, line 81), claim 8 (p. 3, line 125) and claim 13 (p. 4, line 41); also using the oleic acid in the process in the form of soap in which it is recovered from the metalliferous mineral particles (p. 2, lines 9-13).

3. But the most important and most fundamental error of fact in the opinion is with reference to the meaning of the phrase of patent 835120 (p. 1, lines 13-15; R., 1004):

> "or other substances which have a preferential affinity for metalliferous matter over gangue."

This is the phrase which in the view of the Court gives 835120 its anticipating breadth of disclosure.

Of it the Court said in its opinion (p. 2, three lines from the bottom):

> "The nature of the affinity is not specified and it cannot be confined to the kind of action shown by oil."

This matter is of crucial importance because clearly the

> "simple preliminary test * * * to determine which oily substance yields the proportion of froth or scum desired,"

referred to in 835120 (p. 1, lines 61-69) is, and must be, in the view of all, limited to

> "substances which have a preferential affinity for metalliferous matter over gangue."

The broadest scope of the disclosure of 835120 clearly cannot go beyond the meaning of that phrase.

The Court is in error as to that meaning.

835120 does not, it is true, specify the nature of the affinity in question but assumes that its nature is known to persons skilled in the art.

That the nature of that affinity, as so understood in the art, was and must be confined to the kind of action shown by an undissolved substance in an ore pulp, is, we submit, demonstrated by the analysis and quotations from the prior art found in the Appendix, to which we again refer the Court. We also refer to main Brief for Petitioner, pages 76-80, and Reply Brief for Petitioner, pages 1-11.

Although the preferential affinity referred to has been described as a "mysterious affinity"* the mystery is only as to the reason why the affinity exists. There is no mystery as to the manner in which it acts. Given an ore pulp in a state of agitation, the particles of metalliferous matter and particles of gangue moving about in the agitated mixture, and given the presence, disseminated by the agitation through that disturbed mixture, of undissolved particles or fine globules of a substance having this affinity, contact between those globules and the metalliferous mineral particles results in its uniting mechanically with the metalliferous particles and coating them, and contact between those globules and the gangue particles does not result in either union or coating. This is the preferential affinity referred to in 835120. It requires contacts and mechanical union and these presuppose the insolubility that is essential to its action. It produces coated particles of metalliferous minerals. It is not peculiar to froth flotation. It must be present in metal-sinking processes as well. Froth flotation is not evidence necessarily of its presence.

In the process of 835120 the coating of the mineral particles by the preferential action (resulting from preferential affinity) of the oil or oily substance, prepares them for selection by, and adherence to, the air bubbles in the agitated pulp, "such bubbles or air-films," as the patent says (p. 1, line 94; R., p. 1004), "adhering only to the mineral particles which are coated with oleic acid." The preferential action of the oily substance on metalliferous matter over gangue prepares that metalliferous matter for this subsequent preferential action of the bubbles or air films on the coated particles. Here are two preferential actions, quite different the one from the other, the one exercised by the oil for the metalliferous mineral particles (not new with 835120), the other exercised by the air bubbles for such particles when coated (new with 835120), and both essential to the mineral-froth-forming results. But this Court has failed to observe, or has entirely lost sight of, this distinction. The

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* Lord Atkinson in *Minerals Separation* v. *British Ore Syndicate Limited*, 27 RPC, 33, 49, quoted in *Minerals Separation* v. *Hyde*, 242 U. S. 269.

description, however, and the claims of 835120 clearly make the distinction.

Thus claim 12, for example (patent, p. 4, line 17; R., p. 1007), is for a process consisting of three steps, namely, first, coating the mineral with oil in the water, etc., secondly, agitating the mixture to cause the oil-coated mineral to form a froth, and thirdly, separating the froth.

That the prior art (conveniently epitomized in that regard in the Appendix) universally employed and accepted the phrase in question as "confined to the kind of action shown by oil," we submit with confidence, and that prior art is illuminative of the disclosure of 835120 and of the limitations of that disclosure. The preferential affinity of oil and oily substances, whereby they coat the metalliferous mineral particles and not the gangue, was not the discovery of 835120, as this Court said in the *Hyde* case (242 U. S. 261, 264), and as the opinion in this case reiterates (p. 3), but the preferential affinity of bubbles or air films in agitated pulp for the previously coated mineral particles was the discovery of 835120, when and if the oil coating were made very minutely thin, or, as Lord Atkinson phrased it in the House of Lords (242 U. S. 261, 269), when

> "the metallic particles are only coated with a thin film of it."

The discovery of 835120 was predicated on the exceeding thinness of the oil film on the metalliferous mineral particles and the resulting preferential affinity that the bubbles or air films would have for the so thinly coated metalliferous mineral particles over the water-wetted gangue, as contrasted with coatings on the metalliferous mineral particles so thick and therefore so sticky that the particles would adhere together and form granules which sank; and the disclosure of 835120 is limited in that regard to substances which have a preferential affinity for metalliferous matter over gangue and in consequence coat that metalliferous matter even though that coating be exceedingly thin.

The patentees of 962678 discovered that it was not necessary to froth flotation to use a substance which had a preferen-

tial affinity for metalliferous matter over gangue. They discovered that a substance which modified the water by going into solution in it, and so modified the bubbles or air films formed in that water, would cause those modified bubbles or air films to have a preferential affinity for entirely uncoated metalliferous matter over uncoated gangue. This was an additional discovery, a different discovery, and it enabled the operator to form a mineral-bearing froth without the use of an oil or oily substance or any substance having a preferential affinity for metalliferous matter over gangue. On the contrary it relied entirely on the preferential affinity of modified air bubbles for metalliferous matter over gangue.

4. The opinion herein says (page 3, lines 18, 20):

> "But we agree with the defendant's argument * * * that No. 835120 was not describing the work of insolubles alone."

This, we believe and submit, was an error of fact.

835120 was alone describing the work of substances which were capable of *very thinly coating* the mineral particles in preference to the gangue and which thereby invoked the power of air bubbles to attach themselves to such very thinly coated particles in preference to particles wetted by the water.

This power or preference of air bubbles is prefigured in patent No. 793808 to Sulman & Picard, where it is said (R., Vol. II, p. 991, lines 16-19):

> "we utilize the power which is possessed by films or bubbles of air or other gas of attaching themselves to solid particles moistened by oil or the like."

and again (lines 65-70):

> "The oiled metalliferous particles * * * have the power of attaching to themselves with a greater comparative strength than the gangue particles the films or bubbles of gas which exist in the mass * * *."

The very thin coating of 835120, however, was not here disclosed, as this Court in substance held in the *Hyde* case and the *Butte* case.

The power of air bubbles to attach to themselves very thinly coated particles in preference to uncoated particles is disclosed in 835120 (R., p. 1004; p. 1, lines 28-35), and is described at line 94:

> "such bubbles or air-films adhering *only* to the mineral particles which are *coated* with oleic acid." (Italics ours.)

We believe that the prior art as epitomized in the Appendix and summed up by this Court in its opinion in the *Hyde* case, 242 U. S. 261, 264, heretofore quoted, and the definition of the discovery of 835120 given in the opinion herein at page 3, also heretofore quoted, demonstrate the error of the Court in extending the disclosure of 835120 to the work of substances that do not, and cannot, preferentially coat the mineral particles.

5. The opinion of this Court also says (p. 3, lines 14-16)

> "The experts differ whether the same thing does not take place when a soluble substance is used."

We respectfully submit that the record shows a failure of proof in this regard on the part of Respondent, with the burden of proof, as it must be, on Respondent, for it is attacking the validity of a patent by the alleged disclosures of a prior patent.

In behalf of Respondent a theory was put forward as to the action of mineral-frothing agents in solution to the effect that they also coated the solid particles in the pulp. The theory was based upon the molecular phenomenon of adsorption which is not preferential. This theory was not supported by facts and was proved to be irreconcilable with the proved and undisputed facts. It is fully considered in the main Brief for Petitioner at pages 64-70. It is fundamental in scientific work that a theory which is not in accord with the facts must be discarded.

6. The opinion herein says (p. 3, lines 16-18):

> "But we agree with the defendant's argument that no one concerned in this business would care a straw as to the intimate nature of the action if it produced the result, * * *."

In this, we believe and submit, the Court was misled by the argument that the mill man would not care how an operation was conducted if in fact the metalliferous matter really rose in any kind of a froth that could be separated.

This art is peculiar in the respect that every mill has and must have its metallurgical laboratory. No ore concentrating mill ever was constructed, or could be run a single day, except by the painstaking planning, and under the daily supervision, of a highly skilled metallurgist. These metallurgists are technically educated men and they must always first elaborately test and experiment in the laboratory with the ore that the mill is to handle and determine its characteristics and the problems of its grinding and the best concentration processes to be applied to it in its different stages, and in the matter of flotation to determine the best agent or agents to be used and the best conditions, such as temperature, acid, alkaline or neutral water of the pulp, gangue correctives, etc.; and when such an ore-concentrating mill is once successfully operating, the metallurgist in charge would not dare introduce the slightest variation in the procedure until after demonstration of its usefulness by carefully conducted tests in the laboratory and probably also in small scale operations. The risk of wasting valuable metal is too great. These metallurgists are the men skilled in the art to whom the patents of the art are addressed. Those patents are not addressed to the mill men who turn valves on and off, collect samples for assay in the laboratory and do as they are told; who watch against stoppages and overflows and other changes that they learn to detect by the eye. These are mere laborers although designated mill men. Such mill men, as well as the owners of the mills who enjoy the profits of the operations, are generally neither chemists nor metallurgists and they would not understand the meaning of the technical terms used in ore concentration patents, or the difference between a soluble and an insoluble agent, and such mill men and such owners would not care a straw as to the intimate nature of the action.

But the metallurgists in charge would understand such technical terms in the art and such differences and would know

what oleic acid is (the example given in 835120) and what are the substances having a preferential affinity for metalliferous matter over gangue referred to there. Such a metallurgist would know that oleic acid, or other oily substance so defined, would coat the metalliferous particles in preference to the gangue, and would know that in the small quantity prescribed that coating would be very thin and would know that the preferential action of such oleic acid or other oily substance would be enhanced in the case of an acidified pulp and would be further enhanced in the case of a slightly heated pulp. Such a metallurgist would know also what the different substances and classes of substances recited as agents in the patent in suit are, and would know that those agents would dissolve in the water of the pulp and could not coat the mineral particles preferentially or otherwise, thickly or thinly, and would see and know that the froth produced in the case of the patent in suit was different from the froth produced in the case of the oleic acid or other oily substance process of 835120.

The fact is proved in the record, as heretofore stated that, from March, 1905 (when the discovery of 835120 was made), until long after December, 1908 (when the discovery of 962678 was made), all commercial operations of the process of 835120 were carried on with oleic acid as the mineral-frothing agent and a zinc-lead ore as the ore to be concentrated, this applying to Australia and all other parts of the world until July, 1912, in Sweden (main Brief for Petitioner, pp. 46-52).

There was not a word of evidence of any other use of the process of 835120 in ore concentration mills during the period from March, 1905, to December, 1908, and the only evidence of any laboratory uses or investigations were those undertaken in connection with the discovery and invention of the process of 835120, to wit, Higgins' report of March 16, 1905, wherein the surprising results of the use of minute quantities of oleic acid were reported, and it was also reported that crude petroleum, paraffine (kerosene oil) and melted tallow were useless for the purpose (R., Vol. II, pp. 1192-1196), and the report of Sulman and Picard dated May 3, 1905, wherein the action of small quantities of oleic acid was confirmed (R., Vol. II, pp.

1196-1200), and it was stated that petroleum residuum and paraffine oil (kerosene oil) and admixtures thereof (all of them insoluble oils) had been used in the laboratory and gave small proportions of froth and were not as efficient as oleic acid (R., pp. 1200-1201).

7. The opinion herein says, referring to patent 835120 (p. 3, last 8 lines):

> "The public was directed to make a 'simple preliminary test to determine which oily substance yields the proportion of froth or scum desired.' The patent having been held good as to the oils although experiment was necessary to find out what oil would work best with a given ore the disclosure was an anticipation although experiment might be necessary to choose among the substances having the required affinity the one that would produce the best result."

The principal error here is in the misunderstanding of the meaning and effect, as applied to the facts of the present case, of the direction in 835120 to make preliminary tests in the application of the disclosed process to different ores. Additionally there is again the error above pointed out as to the meaning of the descriptive phrase in 835120, "substances having a preferential affinity for metalliferous matter over gangue."

The language of 835120 is as follows (R., Vol. II, p. 1004; p. 1, lines 61-69):

> "The proportion of mineral which floats in the form of froth varies considerably with different ores and with different *oily substances,* and before utilizing the facts above mentioned in the concentration of any particular ore a simple preliminary test is necessary to determine which *oily substance* yields the proportion of froth or scum desired." (Italics ours.)

It is to be noted that this direction is closely limited to oily substances. Further it is part of a specification the broadest disclosure of which is "substances which have a preferential affinity for metalliferous matter over gangue." The meaning of that description and its limitation to insoluble substances

has been heretofore fully considered. The reason for the insertion of this direction is well stated in the decision of this Court in *Minerals Separation, Ltd. vs. Hyde*, 242 U. S. at 270, 271, as quoted in the language in the Brief for Petitioner-Plaintiff at page 35. As this Court then said:

> "The composition of ores varies infinitely, each one presenting a special problem, and it is obviously impossible to specify in a patent the precise treatment which would be most successful and economical in each case."

The skilled metallurgist when asked to decide whether a process may be successfully used with an ore with which it has not theretofore been used, makes "a simple preliminary test," and usually many of them, to determine whether or not the process and the agent under consideration are applicable to this ore, and in what proportions and under what conditions the ore is most successfully concentrated by the process. This is done in the metallurgical laboratory, and the results obtained check and guide and determine the subsequent operations in the mill. It is submitted that the direction in patent No. 835120 was not a general direction to run the gamut of all known substances, but to test first oleic acid and then possibly other substances like it, "oily substances," which would function in the same way in the water of the pulp. It was a direction to test different oily substances in applying the disclosed process to different ores. As this Court further said in *Minerals Separation, Ltd.* v. *Hyde*, and as is also quoted at page 35 in the Brief for Petitioner-Plaintiff:

> "The process is one for dealing with a large class of substances and the range of treatment *within the terms of the claims*, while leaving something to the skill of persons applying the invention, is clearly sufficiently definite to guide those skilled in the art to its successful application, as the evidence abundantly shows." (Italics ours.)

The disclosure in question did not result in anything more, industrially, than the application of the process of patent No. 835120, with oleic acid as the mineral-frothing agent, to the

treatment at several mills in Australia of several zinc-lead ores; and until the knowledge of the invention of the patent here in suit was available, no further progress was made. When the knowledge of the invention of the patent in suit was available, the new process which it disclosed vastly widened the field; but the process of the patent in suit is not the only patented process that has contributed to the tremendous advance that has been made in the art of froth-flotation ore concentration. There have been many such patented improvements in froth flotation processes made since the date of the patent in suit, mostly relating to the agents used, and each improvement that was not obvious from the disclosures that preceded it is surely entitled to the reward of a patent.

The direction in patent 835120 to make a test was simply and only a direction to test the process disclosed in the patent. It is a characteristic of processes in this art that the proportions used are varied in the applications of the processes to different ores. For example, in the Cattermole patent No. 777273, which discloses the invention which was under investigation when the process of patent No. 835120 was discovered and invented, there are similar directions, for the determination, necessarily by test, of that most essential element, the proportion of oily material used, the later substantial reduction of which brought about the discovery of the process of 835120. For example, it is said (R., Vol. II, p. 970, lines 32, 36):

> "if the proportion of oil is kept within reasonably low limits (differing in different cases, according to the nature of the mineral to be treated and the consistency and nature of the oil) * * *"

and again (p. 971, lines 63-66):

> "The proportion of oil used depends upon its viscosity, the fineness of the ore, and other factors, and the consistency and size of the mineral granules desired."

This direction to vary the proportion of oil in the use of different oils and in the application of the process to different ores was held by this Court in *Minerals Separation, Ltd.* v. *Hyde* not to anticipate the discovery of the froth-flotation proc-

ess of patent No. 835120, by a reduction of the amount of oil used in the Cattermole process, without other change in the procedure.

As we have said the work of a testing laboratory is a necessary part of the work of introducing any and every process of ore concentration to use in the treatment of the vast variety of different ores, and froth-flotation processes peculiarly require this work to be done. They are physical processes adapted to deal with a great variety of ores. When the process is known, the variations within that process may be tested and the application of the process to any particular ore must be tested in every case before the process is put into use in the mills. The expenditure of great sums of money in mill construction are based upon this testing work, usually followed by small scale operations, and the final adoption of the process in the treatment of thousands of tons of ore per day only occurs after all this preliminary work has demonstrated the usability of the process.

The disclosure of patent 835120 was that oleic acid, when used in an amount which was a fraction of one per cent. on the ore and in a heated pulp and in the presence of sulphuric acid and subjected to vigorous agitation and aeration, would coat the metalliferous mineral particles and that the coated metalliferous mineral particles would unite with air bubbles and form a mineral-bearing froth. In conformity with the facts of the metallurgical art, this being a physical process which might be found to be applicable to a great variety of ores, and it being the fact that "with different ores and with different oily substances" "the proportion of mineral which floats in the form of a froth varies considerably," it was directed that in determining the applicability of the process to "any particular ore a simple preliminary test" should be made "to determine which oily substance" yielded successful results. The direction for preliminary tests was limited to "oily substances" and the broadest suggestion of the patent was "oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue." Oleic acid is

a fatty acid and an "oily substance" and in an ore pulp exercises such preferential affinity and preferentially coats the metalliferous mineral particles. The entire art prior to the invention of the process in suit had been concerned only with substances functioning by reason of their "preferential affinity for metalliferous matter over gangue" in the mixture of ground ore and water known as an ore pulp, and preferentially coating the metalliferous mineral particles. The exercise of that preferential affinity required insolubility of the substance in the water of the ore pulp.

With this disclosure and knowledge, the patentees of the patent in suit discarded oils, fatty acids and other substances which have a preferential affinity for metalliferous matter over gangue. They conceived the idea that substances which were incapable of exercising this preferential affinity, might be wholly dissolved in an ore pulp, and the ore pulp then agitated and aerated, and that this might in some manner produce a mineral-bearing froth. They tested it carefully and thoroughly over a period of months and found that by a different mode of operation they had produced a different kind of mineral-bearing froth. This, it is submitted, was a patentable invention, and it is the invention which is disclosed and claimed in the patent in suit.

General Considerations.

The following facts of record, taken from the pages of history of a time for the most part long antedating this controversy, and having to do directly with the question whether the process of the patent in suit is disclosed in No. 835120, raise an unusually strong presumption on that question of technical fact, and may have been overlooked by this Court or not given proper consideration and weight, namely:

1. Prior to the issue of the patent in suit, No. 962678, no one anywhere in mill or laboratory had ever attempted to concentrate ores by mineral-froth-flotation by the use of a substance in solution. This was in spite of the worldwide patenting and publication of the 835120 process and its successful use on the zinc dumps and ores at Broken Hill, Australia, and

in spite of the resulting Elmore infringement litigation in England and Australia which threatened the 835120 process with injunction because it employed oil and acid in a flowing pulp, which was what Elmore claimed.

2. From December 8, 1908, when the discovery was made that mineral-froth flotation could be successfully achieved by the use of one particular substance in solution and on through continuous experiments thereafter with other substances in solution, all the experts involved in those experiments (and they were all of them familiar with the process of 835120 and none in the world knew that process better than they) regarded the process employing mineral-frothing agents in solution as novel, and as invention, and as invention of a high order. This is evidenced by the immediate steps that were taken to patent the process in England and in this country. This consideration is adverted to by this Court in the *Hyde* case as "persuasive evidence," along with extensive use, "of that invention which it is the purpose of the patent laws to reward and protect" (242 U. S. 261, 270).

3. The technical men in the Patent Office, skilled in this art, who were called upon by the application for the patent in suit to pass judgment on the question whether the process had been disclosed in 835120, found that it had not been there disclosed. The presumption of validity arising from a fact of this character on a technical issue of this kind has often been emphasized by this Court.

4. The actual benefit to society wrought by the discovery and process of the patent in suit has been so stupendous as to entitle the patent to liberal treatment in order to preserve rather than to destroy it, as this Court has frequently said.

5. The entire art with the exception of the respondent and one other concern has acknowledged and acquiesced in the validity of the patent in suit and has paid large royalties for the use of the process. This is evidenced by the great number of licenses taken out all of which continued after the expiration of 835120 and to the date of expiration of the patent in suit,

over three and one-third years later, and by the payment of substantial royalties during that more than three and one-half years by those licensees, amounting in rate to about one-half of what had been paid for a license under both patents prior to the expiration of 835120. This evidences in the strongest possible way the practical judgment of the experts of the art that the patent in suit is not anticipated by 835120.

6. Certainly five and apparently six of the eight Judges who have heretofore had to pass upon the precise question of anticipation of the patent in suit by 835120 have decided that it is not anticipated, namely, in the *Miami* case, Judge Bradford (237 Fed. 609), Judges Buffington, McPherson and Woolley (244 Fed. 752), and in the instant case Judge Peters (23 Fed. (2d) 731) and apparently Judge Anderson (30 Fed. (2d) 67, 73).

WHEREFORE your petitioner respectfully requests that a rehearing may be granted and that the mandate of this Court may be stayed pending the disposition of this petition.

Very respectfully,

MINERALS SEPARATION NORTH AMERICAN CORPORATION

By HENRY D. WILLIAMS,
of Counsel.

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WM. HOUSTON KENYON,
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Dated, New York, N. Y., March 18, 1930.

We hereby certify that the above petition for rehearing is well founded in law and is presented in good faith and not for delay.

HENRY D. WILLIAMS.
WM. HOUSTON KENYON.
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APPENDIX.

(Italics ours.)

Haynes, 1860 (R., Vol. II, pp. 923-927).

Improvements in obtaining metals from ores.

Adds to powdered ore (R., Vol. II, p. 925, lines 7-11)

> "what I term my 'agent,' which is composed of certain substances *not soluble in water alone,* that is, bituminous matter (coal tar from gas works, and such like, for instance), gums or gummy matter (amongst others, gutta percha, india-rubber, for instance), and fatty or oleaginous matter, and having mixed these together * * *."

(lines 19, 20):

> "when the earthy or foreign matter has separated from the agent and metal, *which alone remain in union,* I remove, * * *."

(p. 926, lines 29-32):

> "the agitation being still kept up, the agent acts upon the metal, and gradually effects the separation of the metal from the earthy or non-metallic matters of the ore or matrix, or ore and matrix, the earthy matter sinking to the bottom of the water, and the metal being retained by the agent."

(line 35):

> "To remove the agent from the metal, I put the agent and metal still in union in a vessel containing an alkaline solution, * * *."

Bessel, 1877—First Patent (R., Vol. II, pp. 929, 930).

(p. 929):

> "The crude impure graphite is mixed with a small quantity (1% to 10%) of an organic substance, which, if liquid, is *not miscible with water or is only slightly miscible,* and which, if solid, is not dissolved or wetted by water."

Then follows a list of twenty substances or classes of substances and it is said (p. 930):

> "The mixture of the graphite with the substance chosen is intimately made so that all parts of the former shall come into contact with said substances."

Bessel, 1886—Second Patent (R., Vol. II, pp. 932-934).

The substances mentioned in the first patent are referred to but especially bitumens particularly including (p. 934)

> "crude and refined petroleum, the by-products of the refining process, paraffine, benzine, mineral oil, mineral tar, ozokerite."

The claim recites purification of graphites by the production of an intimate mixture of the graphites

> "with organic substances *not soluble in water,* especially hydrocarbons in solid and liquid state, fusel oils, etc., * * *."

Everson, 1886 (R., Vol. II, pp. 935-937).

(p. 935, lines 9-14):

> "The discovery which forms the basis of my invention is that metals and metallic substances in a comminuted state *will unite with* compounds of fats or oils and acids, and that such compounds *will not unite with* comminuted quartz or other rocky gangue."

Everson then describes the mingling of ore and water (lines 22-25)

> "for the purpose of effecting *a union* of the free metal or metallic portion of the ore with such admixed material, * * *."

The rocky gangue is then said (line 71)

"to be removed by a washing process".

The claims recite mixing with the ore (p. 937, lines 70, 77)

"a fat or an oil or a constituent thereof".

Robson and Crowder, British, 1894 (R., Vol. II, pp. 940-943).

Describes a mixture of turpentine, petroleum, etc., and a fatty oil which is described (p. 940, lines 29, 30) as

> "capable of *taking up* the said finely divided metallic matter and thus separating it from the substances with which it was previously mixed."

This is spoken of (line 40) as

"a selective action".

Robson, 1897 (R., Vol. II, pp. 947-951).

Speaks of (p. 949, lines 35-40)

> "an oily liquid that is of less specific gravity than water, and is capable of *taking up* the said finely-divided metallic matter and thus separating it from the substances with which it was previously mixed."

The claims (p. 951) refer to the agent (line 27) as

"a fatty substance"

(lines 37, 38):

"a fatty oil"

(lines 62, 63, 69):

"an oily liquid."

Elmore, 703,905, 1902 (R., Vol. II, pp. 952-954).

Is for an oiled belt separator.

Title: Separation (p. 953, lines 7, 8)

"by the selective action of oils and like substances".

So the claims (p. 954, lines 23, 40, 48).

The invention is said to relate to separation (line 11)

"by the selective action of oils and like substances".

Definition (lines 17-20):

"In what follows I shall use the word 'oil' to mean either oil or any other substance that can exert a selective action on minerals *such as oil exerts.*"

Operation (lines 33-40):

"The oil by its selective action *coats or absorbs* the metallic particles, sulfids, tellurids, and the like. * * * the oil *attaches itself to or coats* such particles, while it does not coat or attach itself to the rocky or earthy particles present."

(line 96):

"I find that the action of the oil in selecting some kinds of mineral from other kinds is greatly increased by adding to the pulp a small quantity of acid, such as sulfuric acid or such acid substances as the cuprous liquors from mine-water."

Cattermole, British, 1902 (R., Vol. II, pp. 962-964).

Granulation process.

Relates to separation (p. 963, line 31)

"by means of the selective action of oils on minerals."

Operation:

Granulation (lines 45-47)

> **"agglomerated or granulated by the oil which *adheres in the form of a thin film* to the metalliferous constituents, which tend to sink."**

Specifies what oils may be used (p. 964, lines 5-9):

> **"Any animal, vegetable or mineral oil may be used, which alone or in conjunction with an emulsifying agent has the property of *picking up* metalliferous mineral particles; for example linseed oil, lard, paraffin or light hydro-carbon oil, heavy hydro-carbon oils, preferably mixed with a fatty acid or fatty oil, also act well."**
>
> **(line 19):**
>
> **"In order *to recover the oil from the granules,* they are subjected to the action of emulsifying agents * * *."**

Cattermole, 763260, 1904 (R., Vol. II, pp. 969-972).

A granulation process.

> **(p. 970, lines 20-28):**
>
> **"when a mixture of powdered metalliferous matter and gangue is treated with oil suspended in water—that is to say, in emulsion—the oil has a more or less selective action *and will coat the particles* of metalliferous matter in preference to the particles of gangue, while the particles of gangue will be wetted by the water; * * *"**
>
> **(lines 38-40):**
>
> **"the metalliferous particles which have become *coated with oil* will *adhere together* and form granules, * * *"**
>
> **(p. 971, lines 89-94):**
>
> **"The oil used may be animal, vegetable, or mineral oil, or mixtures of these, or such coal or wood tar products or other substances which exercise, like oils, a *preferential physical affinity* for metallic mineral matter as distinguished from gangue."**

Cattermole, 777273, 1904 (R., Vol. II, pp. 973-977).

Granulation process.
Describes separation (p. 974, lines 12-15):

"by means of the selective action of oils and certain tar products or similar compounds (all hereinafter referred to as 'oil') on metallic or metalliferous matter."

(lines 20-24):

"the oil has a more or less selective action *and will coat* the particles of metalliferous matter in preference to the particles of gangue, while the particles of gangue will be wetted by the water."

(lines 34-36):

"the metalliferous particles which have become *coated with oil* will *adhere together* and form granules."

(p. 975, lines 89-94):

"The 'oil' used may be animal, vegetable, or mineral oil or mixtures of these or such coal or wood tar products or other substances which exercise, like oils, a preferential *physical* affinity for metallic mineral matter as distinguished from gangue."

The claims recite (p. 976, lines 85, 95, 105, 115, 125):

"until the *oil-coated* metalliferous matter is agglomerated into granules."

(p. 977, lines 6 and 15):

"granules of *oil-coated* particles."

Cattermole, Sulman & Picard, British, 17109 of 1903 (R., Vol. II, pp. 978-981).

A soap process.

(p. 979, lines 40-45):

"Our process has for its object the separation of minerals from the siliceous or earthy matters of ores by means of soaps or similar compounds, and is dependent

upon the *superior physical attraction* exhibited by minerals for fatty or resin acids, or for certain other aromatic derivatives (such as cresols, phenols, etc.) which form soluble salts or compounds with alkaline hydrates, as compared with earthy or siliceous substances."

(p. 980, lines 6-10):

"It is found that the liberated acids, etc., which may even be solid under ordinary conditions, are *precipitated and adhere to* the sulphuretted minerals, or to sulphur, graphite, or free metals present in the ore, leaving the gangue or earthy particles preferentially wetted by water, and free from adhesions of fatty acid and the like."

Claim 1

(p. 981, lines 7-9):

"whereby the fatty acid is *liberated and adheres* to the mineral having an affinity therefor but not to the gangue".

Claim 2

(lines 12-14):

"separating the *coated mineral matter* from the non-coated gangue and removing the fatty or resin acid from the metalliferous matter by adding alkali".

While it is true that the cresols and phenols here referred to may be used in such a way that they will wholly dissolve in the water of the pulp, they may, on the other hand, be used in such a way as not to dissolve but to remain undissolved—as by previous saturation of the water of the pulp. Manifestly they must be used in the latter way, that is, with a previously saturated pulp, in this Cattermole soap and granulation process, so that, when chemically formed from their phenylates or cresylates (soaps), they will be "precipitated and adhere to the sulphuretted minerals," and the coated minerals will adhere together to form granules. That is Cattermole's requirement, so manifestly they must be used in that way and no other.

The evidence shows that phenol and cresol were never in fact used to carry out the Cattermole granulation process in which

only was their use disclosed (in the soap form or any other form of that process), and that the necessary preliminary saturation of the pulp to cause phenol and cresol to operate in that way would be prohibitively expensive (see main Brief for Petitioner, pp. 88-90).

Cattermole, Sulman & Picard, 777274, 1904 (R., Vol. II, pp. 982, 983).

A soap process.

As in the last above British patent fatty or resin acids are named and also cresols, phenols, etc., but the statement as before is (p. 982, lines 42-60):

> "It is found that the liberated acids, &c., which may even be solid under ordinary conditions, are *precipitated and adhere to* the sulfureted minerals or to sulfur, graphite, or free metals present in the ore, leaving the gangue or earthy particles preferentially wet by water and free from adhesions of fatty acid and the like. The fatty acid and the like used for the purpose of *adhering to* the mineral particles is thus produced *in situ* throughout the suspended ore mass in the most intimate contact or admixture therewith, and the mineral particles *become attached to or more or less coated by* films of fatty or resin acid. * * * the coated metalliferous particles *adhere together* and form granules".

Claim 1 refers (p. 983, lines 9-11) to

> "the organic acid which *coats* the desired mineral particles but not the gangue".

Claim 2 refers (lines 19, 20) to

> "agitating the mixtures so as to agglomerate the *coated* mineral particles into granules".

Here, as before, the cresols and the phenols referred to are and must be so used as to carry out that which the Cattermole specification prescribes and the claims require in the way of *coating* the mineral particles (see main Brief for Petitioner, pp. 91, 92). There could be no more conclusive demonstration

of the fact that oleic acid actually coats the mineral particles than the existence of this granulation process which requires, and proceeds by, the mutual stickiness of contacting coatings; and of the fact that this reference to phenol and cresol is to such a use of them as will coat the mineral particles and coat them to the point of stickiness so that they will form granules.

Sulman and Picard, 793808, 1905 (R., Vol. II, pp. 988-992).

Described as concentration (p. 991, lines 12-15)

> "by means of oils, grease, tar, or any similar substance which has a *preferential affinity for metalliferous matter over gangue.*"

Defined as (line 19):

> "solid particles *moistened* by oil or the like."

Operation (lines 61-64):

> "The minute oil globules or the condensed vapors or volatile oils *attach themselves to* the metalliferous particles in preference to the gangue."

Metalliferous particles are referred to (line 65) as

> "The *oiled* metalliferous particles".

The inventors say (lines 16-19):

> "According to this invention we utilize the power which is possessed by films or bubbles of air or other gas of attaching themselves to solid particles moistened by oil or the like."

(lines 65-70):

> "The oiled metalliferous particles * * * have the power of attaching to themselves with a greater comparative strength than the gangue particles the films or bubbles of gas which exist in the mass * * *."

These bubbles buoyed the mineral particles up to the surface and then burst and left them there, to float by the greased needle effect (film or skin flotation) or to sink. Too much oil was used.

SUPREME COURT OF THE UNITED STATES.

No. 71.—October Term, 1929.

Minerals Separation North American Corporation, Petitioner, *vs.* Magma Copper Company.	On Writ of Certiorari to the United States Circuit Court of Appeals for the First Circuit.

[February 24, 1930.]

Mr. Justice Holmes delivered the opinion of the Court.

This is a suit for the infringement of Letters Patent, No. 962678, Claims 1 and 2, brought by the petitioner in the District Court of Maine, where the petitioner prevailed, (23 F. (2d) 931,) the Court acting partly in deference to the decision of the Circuit Court of Appeals for the Third Circuit in *Miami Copper Co.* v. *Minerals Separation, Ltd.*, 244 Fed. Rep. 752. The decision of the District Court was reversed by the Circuit Court of Appeals for the First Circuit, 30 F. (2d) 67, and because of the conflict with the Third Circuit, a writ of certiorari was granted by this Court.

The claims are (1) for a "process of concentrating ores which consists in mixing the powdered ore with water containing in solution a small quantity of a mineral frothing agent, agitating the mixture to form a froth and separating the froth", and (2) the same as (1) except that it inserts the word 'organic' before 'mineral frothing agent'. The only defence that it is necessary to consider is that the disclosure is anticipated by the earlier patent, No. 835120, which has been before this Court in *Minerals Separation, Ltd.* v. *Hyde*, 242 U. S. 261, and *Minerals Separation, Ltd.* v. *Butte & Superior Mining Co.*, 250 U. S. 336. It is enough to refer to those cases without repeating them. The process described in 835120 "consists in mixing the powdered ore with water, adding a small proportion of an oily liquid having a preferential affinity for metalliferous matter, (amounting to a fraction of one per cent. on the ore), agitating the mixture until the oil coated mineral

matter forms into a froth, and separating the froth from the remainder by flotation." The specification describes the object as being to separate metalliferous matter, &c., from gangue by means of oils, fatty acids, "or other substances which have a preferential affinity for metalliferous matter over gangue". It refers to a previous patent to Cattermole by which a considerable amount of oil is used to form granules, and announces the discovery that if the proportion of oily substance is reduced to, say, a fraction of one per cent. on the ores, granulation ceases to take place, and on vigorous agitation the ore instead of sinking forms a froth on the surface that can be removed. The process is helped by the addition of a little acid, by warming and the fine pulverization of the pulp.

The petitioners, admitting that both patents are for processes, says that they are fundamentally different in their respective principles of action; that in the present patent, 962678, the mineral frothing agent is dissolved in the water and produces the metal bearing bubbles, no one knows exactly how, by 'modifying the water'; whereas in the earlier, 835120, oil is used which does not dissolve in the water but coats the particles of metal with a thin coating of oil, which it could not do if it were soluble, and thus shows its preferential affinity when shaken up with the metal pulp.

The question is not what is the precise scope of the claims in 835120, but what is disclosed in the specification and made known to the world. *Alexander Milburn Co.* v. *Davis-Bournonville Co.*, 270 U. S. 390. Therefore we are relieved of the inquiry whether the words 'oily liquid' in Claim (1) can be read as a shorthand expression for the previously mentioned oils 'and other substances which have a preferential affinity for metalliferous matter over gangue', as 'oil' was expressly interpreted in earlier patents, including one to Cattermole referred to at some length in 835120, and as there is evidence that it thus was understood by men skilled in the art. It is disclosed that it was well known there were other substances besides oil that had the preferential affinity and that could be used. The nature of the affinity is not specified and it cannot be confined to the kind of action shown by oil. It is neither said nor implied that the added element must be insoluble

or that it must coat the metal, although it is assumed in accordance with the prevailing theory that the metal will be coated when the oil mentioned in the claims is used. All that is required is that in some effective way the other substance should pick the metal out. It is said that oil does it by coating the metal particles and that of course a substance in solution could not do that. There is no 'of course' as to what nature can do, except as proved by observation and experiment. A substance in solution can combine chemically with another and become a solid. Whether a given thing will unite mechanically or whether by its presence it will promote an activity in which it does not share, is to be found out by trial not by reasoning, and the petitioner agrees that in this case we do not know. It is a matter of reasoning rather than of observation that the oil coats the mineral particles. The experts differ whether the same thing does not take place when a soluble substance is used. But we agree with the defendant's argument that no one concerned in this business would care a straw as to the intimate nature of the action if it produced the result, and that No. 835120 was not describing the work of insolubles alone. It was not attempting to anticipate a theory of the invisible, but to tell how the practical end could be achieved with any of the different things named.

The discovery was that a very minute portion of the oil worked in an unexpectedly different way from that familiar with larger quantities—not in the matter of coating the particles, but in helping to produce a froth that floated instead of granules that sank, and thus in preserving the slime made by the smaller particles with the water, and so saving a large proportion of metal that otherwise would have been lost. The fact was a general one. No particular oil was mentioned and the fact was not confined to oils. The public was directed to make a 'simple preliminary test to determine which oily substance yields the proportion of froth or scum desired'. The patent having been held good as to the oils although experiment was necessary to find out what oil would work best with a given ore the disclosure was an anticipation although experiment might be necessary to chose among the substances having the required affinity the one that would produce the best result.

The petitioner adverts to the success that has attended the later patent and to the fact that the world waited until it appeared. But interlopers naturally would be slow to venture into the field occupied by a powerful company armed with patent No. 835120 and supported by a subtle ingenuity that we cannot doubt would have been exercised with even more effect to show that a process like that in No. 962678 was an infringement than it now is to prove that the later patent was a revelation that transformed the art.

Decree affirmed.

A true copy.

Test:

Clerk, Supreme Court, U. S.